SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER 1925.

GENERAL PHYSICS.

2201. *Density of Methyl Chloride.* **T. Batuecas.** (Comptes Rendus, 180. pp. 1929–1932, June 22, 1925.)—Describes the two methods used for the preparation of the gas and the results of the density measurements. The mean value obtained for the weight of the litre of gas is 2·3084 gms. correct to about 1 part in 10,000. D. Berthelot's law of limiting densities is found to apply to this gas as to methyl oxide [see Abstract 3 (1925)]. J. W. T. W.

2202. *A Microturbidimeter.* **O. E. Conklin.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 573–580, May, 1925.)—Measures relative turbidity of liquids in small quantities by the thickness of film necessary to cause the disappearance of an incandescent filament. The cell consists of a lens pressed against a sheet of plate glass, the liquid being between. It is mounted on a lever above a lamp with a straight filament, which is observed through a microscope. The cell is centred and the distance between the points at which the filament disappears is measured—magnified—by moving the lever. By comparison with a standard, which is a concave lens ground on a piece of flashed opal glass, it is possible to eliminate personal equation, and results are reproducible to within 2 %. Among possible applications suggested are: determination of butter-fat in milk; standardisation of pigments with respect to particle size; covering power of paints; study of bacteriological cultures. W. G. B.

2203. *A Surveying Barograph.* (Journ. Sci. Instruments, 2. pp. 280–288, June, 1925.)—The article describes a new type of surveying barograph which has been designed by Negretti and Zambra to meet certain requirements specified by the Survey Laboratory of Canada with regard to calibration, creep, friction, temperature change, etc. Details of construction of the instrument and a summary of results obtained with it are given. AUTHORS.

2204. *Rheostatic Method for Registering or Magnifying Displacements at a Distance.* **F. J. Schlink.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 661–667, June, 1925.)—Description of a device which, being simple, compact and capable of construction in a few hours, has advantages over more elaborate displaceometers. It has the disadvantage of registering in discrete steps rather than as a continuous function, but affords sufficient precision in many practical problems where a total displacement of 1 mm. or more is available which needs to be read to a precision of about 0·05 mm. and an accuracy of about 0·002 mm., and when a frictional retarding force of 5 gms. maximum can be tolerated. An elementary form of successive contact displaceometer was described in the Phys. Rev. 19. 3. pp. 271–272, 1922, electrical contact being made on lines drawn with a carbon-base drawing ink. This has, however, certain obvious limitations, and a method was therefore developed by which the individual contacts could be uniquely discriminated and uniformly spaced without special skill in use. It consists primarily of a resistance of fine wire wound on a cylindrical former, the successive turns being in mechanical contact but electrically well insulated. The insulation is removed in a strip 2 mm. wide along an element of the cylinder. A contact spring or brush travels along this path, making contact successively with the turns of the coil. For full details of the construction the original paper should be consulted. The ordinary use of the device is for reproducing linear or angular deflections at a distance, such as the amount of the opening of a valve. In such applications, using a pivot galvanometer, it serves as an inexpensive substitute for the induction balance. By a combination of two displaceometer elements, one actuated by piston displacement and the other by the deflection of a piston loaded with a much stiffer spring than that used in the ordinary engine indicator, a remote recording engine indicator capable of registering correctly at high speeds can be easily prepared, and, when an oscillograph is available, at a lower cost than the elaborate optical devices in use. On account of the cheapness of the device and the ease of reproducing it in case of accident several other applications suggest themselves. Illustrations are given of oscillograms obtained. E. F.

2205. *Measurement of Viscosity, especially of Oils.* **R. v. Dallwitz-Wegner.** (Zeits. techn. Physik, 6. 6. pp. 221–225, 1925.)—Describes a "scale-viscometer" and a "viscoscope." The former allows viscosity to be measured without measuring time. A vessel provided with an overflow tube at the top contains the oil and a sinker lowered into it by clockwork delivers it along the overflow tube at a known constant rate. The oil then enters one limb of a **U**-tube, the other containing a capillary tube with an overflow tube just above. When a steady state is reached, the head of oil, h, in the first limb is read from a scale behind. Then $\mu = C\rho h$, C being the instrumental constant, and ρ the density of the oil. Four interchangeable capillaries are provided, so that any liquid can be dealt with, and the whole is immersed in a bath so that temperature effects can be studied. The "viscoscope" enables viscosity to be measured under pressure—a point of technical importance. Two spheres, one heavier than the other, are connected by a fine string passing over a pulley, and move centrally in two vertical tubes. These are contained in a vessel full of oil under pressure. The pulley can be rotated by an external key, which can be disconnected at will. The heavier sphere being at the top, it is so disconnected, and the resulting (slow) angular velocity of the pulley observed. The viscosity is inversely proportional to this. W. G. B.

2206. *The Kinetic Theory of the Compressibility of Solutions and of Binary Liquid Mixtures.* **K. C. Kar.** (Phys. Zeits. 26. pp. 465–467, July 31, 1925.)—Derives new formulæ, by means of statistical mechanics, for the relation between the compressibility of solutions and mixtures of liquids and the concentration. These formulæ are tested by means of the high-pressure experiments of Schumann and Drecker, and are confirmed by them. H. N. A.

2207. *Compressibilities of Organic Liquids.* **J. Hebeisen.** (Ann. d. Physik, 77. 2. pp. 216–224, July, 1925.)—The piezometer method of Röntgen and Schneider is used to determine the compressibilities of eight organic liquids relative to water. From these values the absolute compressibilities are calculated by taking as standard the Röntgen results for water. Some results are: *paraldehyde* (12·13° C.), 82·144; *anisole* (11·87° C.), 60·416; *benzylalcohol* (17·85° C.), 46·429; *ethyl-benzene* (17·89° C.), 82·364; *m-cresol* (17·78° C.), 49·914; *aniline* (17·95° C.), 44·714; *acetone* (18·32° C.), 121·182; and *nitro-methane* (18·36° C.), 69·440 × 10^{-6}. The compressibilities are determined for each liquid at two temperatures, so that by assuming a linear relation between temperature and compressibility the temperature coefficient is calculated for each liquid. W. H. Ge.

2208. *Compressibility and Molecular Weight of Methyl Chloride.* **T. Batuecas.** (Comptes Rendus, 181. pp. 40–42, July 6, 1925.)—The factor expressing the departure of this gas from Avogadro's law diminishes as the pressure is reduced. For a pressure of about 1 atmos. it is equal to 1·0247. This indicates that the molecular weight is 50·493, which gives Cl = 35·470. The pressure coefficient of the compressibility per mm. is 31·7 × 10^{-6}. J. W. T. W.

2209. *Osmotic Pressure of Hæmoglobin.* **G. S. Adair.** (Roy. Soc., Proc. 108. pp. 627–637, Aug. 1, 1925.)—Discusses experimental methods, sources of error and causes of variations in osmometer readings, particular attention being given to criteria which may serve to distinguish true osmotic pressures from temporary diffusion pressures and false equilibria. In certain solvents the osmometric observations on hæmoglobin remained constant within 6 % for nine weeks, and no products of protein breakdown could be detected in the outer liquids. Under certain conditions the osmometer method can give results accurate to 0·1 mm. of mercury, which corresponds to about 1/100,000th of a degree in depression of the freezing-point. W. H. Ge.

2210. *On the Impact between Two Bodies moving in Rectilinear Paths with Constant Velocities.* **G. Lübeck.** (Zeits. f. Physik, 33. 4. pp. 302–305, 1925.)—It is accepted that during impact in general a part of the kinetic energy is transformed into potential. In the present mathematical paper the converse is shown to be theoretically possible. H. H. Ho.

2211. *Elastic After-effect and Plasticity.* **R. Becker.** (Zeits. f. Physik, 33. 3. pp. 185–213, 1925.)—It is shown that the Boltzmann theory of the elastic after-effect can be derived in its most general form from the assumption of a plastic inhomogeneity of material when the plasticity is regarded as proportional to the velocity of flow. Since, however, the plasticity of metals certainly does not obey this law, a modification of the Boltzmann theory is necessitated. This is derived under the assumption that the flow of metals takes place in separate discrete events according to the probability law. The consequences of this assumption are evaluated for certain cases accessible to experiment. The subject is treated in four sections: § 1. The Boltzmann theory. § 2. Plastic inhomogeneity as cause of the after-effect. § 3. Quantitative investigation of the v. Wartenberg theory. § 4. Consideration of the actual plastic properties of metals. H. H. Ho.

2212. *Plastic Deformation of Iron and the Formation of Neumann Lines.* **W. Rosenhain** and **Jean McMinn.** (Roy. Soc., Proc. 108. pp. 231–239, June 2, 1925.)—Gives the results of experiments carried out with a view of ascertaining the effect of wide variations in speed on the mechanism of deformation in plastic metals. Rapid deformation obtained by shock is accompanied in iron by the appearance of Neumann lines. Slow deformation of the same metal produces slip bands. The Neumann lines correspond to the intersection with the observed surface of lamellæ or plates and not of thin rods of a thickness comparable with their own width [see Abstract 753 (1925)]. Both types of distortion can be produced in the same specimen of iron if a rapid blow is succeeded by a gradual deformation; the slip bands thus produced cross the pre-existing Neumann lines quite irregularly, with or without change of direction. This result shows that the Neumann cannot be twinning layers, as such layers would produce a uniform angular deviation of slip bands. Neumann lines cannot be developed in iron immediately after a small amount of deformation slowly produced. The recovery of the normal behaviour after slow deformation is attained at a rate varying with the purity of the metal and the coarseness of crystallisation. C. O. B.

2213. *An Extension of the Theorem of the Virial.* **E. A. Milne.** (Phil. Mag. 50. pp. 409–414, Aug., 1925.)—This mathematical note points out that the theorem of the virial remains true if the particles are acted on by frictional forces proportional to their velocities in addition to the forces X, Y, Z, *i.e.* frictional forces proportional to velocities can be emitted in computing the virial. In many cases the presence of frictional forces forbids the existence of a steady state, so that the extension of the theorem is of limited application, but its utility is illustrated in the paper for forced vibrations, motion of a star-cluster in a resisting medium, Brownian motion, and the pressure of radiation on the molecules of a gas which is in a steady state. H. H. Ho.

2214. *An Approximate Method of Calculating the Motion of Certain Vortex Rings.* **G. Bouligand.** (Comptes Rendus, 180. pp. 2019–2021, June 29, 1925.)—The equations of motion of a ring formed by the spontaneous combustion of a bubble of PH_3 are obtained from an approximate formula for the kinetic energy by use of Lagrange's equations and without reference to the methods of classical hydrodynamics. The equations so obtained agree with the results of Sadron. W. G. B.

2215. *On the Graphical Determination of the Meridian Paths of Turbine Blades.* **Eydoux.** (Comptes Rendus, 181. pp. 69–70, July 15, 1925.)—In a preceding note [see Abstract 2006 (1925)] the author has shown that in a gyratory flow with velocity potential the velocity components are of the form $v_r = \partial\phi/\partial r$, $v_z = \partial\phi/dz$, $v_n = a/r$, where a is the gyratory constant. If a turbine be set in the flow for development of mechanical energy, calculation shows that the tangential component of the vertex does not enter into the blade reactions. Based upon Lorenz's differential equation for this motion, the author describes a graphical construction for the curves $rv_n =$ const., which show the energy exchanges, these curves being in a meridian plane owing to the above condition. H. H. Ho.

2216. *On the Performance of Windmills.* **L. Breguet.** (Comptes Rendus, 180. pp. 2017–2019, June 29, 1925.)—Mathematical—a formula for the maximum amount of work that can be extracted from the wind being obtained. It is concluded that the sails of the old Dutch type of mill are better formed to obtain the maximum results than the newer American type. W. G. B.

2217. *Wave Resistance—the Effect of Varying Draught.* **T. H. Havelock.** (Roy. Soc., Proc. 108. pp. 582–591, Aug. 1, 1925.)—In studies of the theory of wave resistance for bodies whose water plane section was of reasonably ship-like form, the draught was usually assumed to be infinite. The paper treats of a similar model with vertical sides but with a finite draught, and is mathematical throughout. It is shown that the resistance at different speeds depends on the draught, and also the interference effects due to bow and stem waves are investigated with regard to varying draught. These effects become less prominent with diminishing draught, but with the maxima and minima in the same positions. If the ratio of draught to length is of the order of the values in actual ship models, a comparison can be attempted between the absolute theoretical values and experimental results. S. G. B.

2218. *Velocity of Propagation at a Wave of Compression in Reinforced Concrete Conduits.* **de Sparre.** (Comptes Rendus, 180. pp. 1626–1629, June 2, 1925.)—The formula obtained is

$$\frac{1}{a^2} = \rho\left\{\frac{2R}{E'(\alpha e + e')} + \frac{1}{\epsilon}\right\}$$

a being the velocity, ρ the density, and ϵ the bulk modulus of the liquid, R the radius, E′ Young's modulus for the reinforcement, αE′ that of the concrete, e and e' the thicknesses of concrete and reinforcement respectively. It is assumed that the thickness is small compared with the radius. W. G. B.

2219. *A General Vector Analysis, with Applications to Electrodynamical Theory.* **H. T. Flint.** (Roy. Soc., Proc. 108. pp. 418–455, July 1, 1925.)—A system of vector analysis in which a vector $\delta a'$ of infinitesimal length is defined by the equation $\delta a' = \sum_n \iota^n \delta x^n$, δx^n being a component measured in any system of coordinates, is developed. The vector notation employed bears the same relation to the Riemann-Christoffel tensor calculus as does the Cartesian notation to Hamilton's or Gibbs' calculus, and leaves the formulæ of ordinary vector analysis almost unchanged in form whilst permitting the formulæ of the special theory of relativity to be carried over to the general theory by merely applying the rules of generalised vectors to them. J. S. G. T.

2220. *A Method of Studying the Inertial Forces in Aeroplane Manœuvres.* **E. Huguenard, A. Magnan** and **A. Planiol.** (Comptes Rendus, 180. pp. 1899–1901, June 22, 1925.)—Records results obtained upon an aeroplane in flight by use of the accelerograph designed by the writers [see Abstract 772 (1925)]. The acceleration normal to the plane was measured while looping, etc., and it was found that the machine was subjected to a force from five to six times its weight at times. W. G. B.

2221. *Inner Crystalline Structure of Ferrite and Cementite in Pearlite.* **N. T. Belaiew.** (Roy. Soc., Proc. 108. pp. 295–306, June 2, 1925.)—A method has been adopted for the examination of the inner crystalline structure of ferrite and cementite in pearlite. The method consists in examining under high-power magnification up to 4000 diameters such pearlite grains as lie close to or in the section of the specimen. The apparent width of the cementite or pearlite lamella increases as sec. ω, where ω is the angle of inclination of a secant plane. Consequently the number of details is increased in proportion. Examination of a cementite lamella under magnifications up to 4000 shows its petal-like shape and curvature. The exposed edge of the lamella is usually "saw-like." The "steps" are rectangular, and their examination points to the conclusion that the cleavage occurs through a definite linear unit, *viz.* about 250–300 $\mu\mu$. Microscopic analysis of the ferrite lamella reveals the existence of small "isolated cubes." Their edge is about 250 $\mu\mu$. Similar cubes are reproduced in a Damascene blade. It is suggested that every ferrite lamella is built up of a multitude of such small units or cubes, and, further, that the small cubes are perfect crystals and are similarly but uniformly oriented. Their dimensions are of the order of magnitude of the wave-length of light. Every pearlite grain during and after its formation is subject to stresses resulting from the change in iron from the face-centred to the cube-centred lattice. Reacting to these, the cementite lamellæ get warped and twisted, and to a certain extent give rise to steps in the cleavages. Eight microphotographic reproductions are included in the paper. E. H. B.

2222. *On the Flow Resistance of Metallic Crystals.* **O. Haase** and **E. Schmid.** (Zeits. f. Physik, 33. 5–6. pp. 413–428, 1925.)—It has been proved during recent years that the flow resistance of metallic crystals is by no means a constant independent of the previous working of the metal. By employing very small extensions, by which the position of the slip surface remains practically unchanged, Polányi and Schmid [see Abstract 2016 (1925)] have been able to study the flow resistance, and the present paper records the further development of this work. An increase of the elasticity limits during very slight stretching has been established for several metallic crystals. The true elastic limits of the metals investigated appear, however, to depend on the lattice. The rise of flow resistance during extension increases very considerably with the rate of extension. The recovery of tin and bismuth crystals has been studied by observation of the flow velocity. The elastic limits of zinc appear to be characterised by a constant tension in the slip surface. Full experimental details, with diagrams, are included. H. H. Ho.

2223. *Crystal Recovery. Observations on the Softening of Hardened Tungsten Crystals.* **F. Koref.** (Zeits. f. Metallkunde, 17. pp. 213–220, July, 1925.)—It is shown that thin tungsten wires (from 0·160 mm. diameter downward), consisting of one or several monocrystals, after being hardened by being drawn down through a die, can be softened again by heating to a temperature of 2100° C. or higher for ten minutes. This recovery (*Vergütung*) takes place without any breaking up of the monocrystals into irregularly oriented small crystals (recrystallisation), and it is shown that the breaking strength of the wire in grammes per sq. mm. becomes the same as before the wire is drawn down. If, however, a certain limit of reduction in the diameter by wire-drawing is exceeded, it is found that heating produces recrystallisation and that the monocrystals do not recover. The amount of cold working which allows of recovery without recrystallisation depends on the dimensions of the specimen, and when these are at all large a very small amount of cold working makes recovery in the above sense impossible. A theory of the recovery of small monocrystals is given. The softening of wires made up of irregularly oriented microcrystals (*Vielkristallen*) by heat treatment is also dealt with; it is shown that the density increases and the hardness diminishes at temperatures below that at which recrystallisation takes place, where according to R. Becker, there are also changes in the electrical conductivity and its temperature coefficient. H. N. A.

2224. *The Crystal Structures of Cæsium Tri-iodide and Cæsium Dibromo-iodide.* **R. M. Bozorth** and **L. Pauling.** (Am. Chem. Soc., J. 45. pp. 1501–1571, June, 1925.)—Clark and Duane found certain peaks in the X-ray spectra reflected from crystals, which they interpreted as due to X-rays characteristic of elements in the crystals, produced under the influence of the impinging beam [see Abstract 1185 (1924)]. Among the crystals studied were CsI_3 and $CsIBr_2$, and structures were worked out from the observations which were similar for the two salts. Investigations were made by the present authors independently of one another, and they both have arrived at the same structure, which differs from that of Clark and Duane.

	Cæsium Tri-iodide.			Cæsium Dibromo-iodide.	
	Clark and Duane.	Bozorth.	Pauling.	Clark and Duane.	Pauling.
	Å.	Å.	Å.	Å.	Å.
d_{100}	4·50	6·83	6·80	4·26	6·57
d_{010}	6·43	9·89	10·00	5·91	9·18
d_{001}	7·04	11·00	11·02	6·90	10·66

The probable space-group is V_h^{16}; this is based on Laue diagrams and reflections from prism planes. There are four molecules in the unit, while Clark and Duane found only one molecule in the unit. The density calculated from the Clark and Duane structure is 4·18, while that directly determined is 4·47 in the case of CsI_3. The authors' value is 4·51 g. per c.c., in good agreement with this. Attention is called to an article by Armstrong, Duane and Havinghurst [Abstract 1907 (1925)], which shows that the abnormal peaks observed by Clark and Duane were due to reflections from small crystals with axes slightly displaced from those of the main crystal. No abnormal curves corresponding to the reflection of characteristic radiation of iodine, etc., were obtained with perfect crystals. H. N. A.

2225. *Precision Measurements of the Lattice Constants of Twelve Common Metals.* **W. P. Davey.** (Phys. Rev. 25. pp. 753–761, June, 1925.)—The lattice constant *a* has been determined within 0·1 % (0·03 % for W) for aluminium, iron, nickel, copper, molybdenum, palladium, silver, tungsten, platinum, gold, lead and bismuth by direct comparison with NaCl, a(NaCl) = 2·814 Å. As pure samples as could be obtained were used, from 99·55 % for Ni to 99·9995 % for tungsten, and in many cases commercially pure samples were also measured for comparison. The results for the purest samples are summarised in Table XIII. The density from the X-ray data is in each case (except Al and Ag) greater than the density of the bulk metal as given in the literature, the difference being rather large for Mo (10·21 vs. 9·1), for Pd (12·25 vs. 11·9) and W (19·32 vs. 18·77). For pure W remarkably sharp lines were obtained. For Bi a piece of single artificial crystal was used. AUTHOR.

2226. *The Crystalline Structure of Inorganic Salts.* **W. L. Bragg.** (Roy. Inst. Gt. Britain. Advance proof received Aug. 4, 1925. Nature, 116. pp. 249–251, Aug. 15, 1925.)—In inorganic crystals the bonds between atom and atom do not appear to be limited to certain directions as in organic crystals; the molecule is more fluid, and an addition to one part profoundly disturbs the relationship of all the rest. The number of atoms in the inorganic molecule is generally smaller than in the organic, and the atoms are often arranged symmetrically, which makes the X-ray investigation easier. The fact that it is often possible to replace one atom by another heavier one, with similar chemical properties, without altering the crystalline structure sometimes makes it possible to fix the position of the atom in question. The process is compared with the use of dyes for staining the different parts of a microscopic preparation. The lecturer has considerably altered his views with regard to the magnitudes of the atomic domains; the new values obtained by other workers seem to represent the facts far better than his original figures, and a more complete knowledge of crystal structures has shown that the atomic domain is very elastic. In the case of the homopolar link the atomic domains overlap, and the distance between the atomic centres is greatly diminished; it seems as if the electronic orbits were actually linked up. Photographs of models of rock-salt, iron pyrites, calcite, aragonite, aluminium oxide, spinel and lithium potassium sulphide are given to illustrate the lecturer's views. H. N. A.

2227. *X-Ray Examination of Iodo-Succinimide.* **Kathleen Yardley.** (Roy. Soc., Proc. 108. pp. 542–547, July 1, 1925.)—The unit cell deduced from X-ray measurements differs from that derived from external measurements, $a : c = 1 : 2{\cdot}469$ or $= 1 : 2{\cdot}471$ (Tutton). On this basis all the spacings observed have the full calculated values, except that of the (001) planes, where only the fourth, eighth and twelfth order reflections were found. There are four molecules per cell. A comparison of the intensity of the reflections from the different planes and investigation of a Laue photograph taken by M. Mathieu led to the conclusion that the crystals do not really possess ditetragonal pyramidal symmetry, but belong either to the C_4^2 space group, which possesses a tetrad screw axis of translation, or to C_4^4, which has an axis similar but in the opposite rotatory sense. There are only axes of symmetry and no planes or centres of symmetry in these space groups, and the crystals may be expected to show optical activity, which has since been found to be the case by Tutton. [See next Abstract.] H. N. A.

2228. *The Crystallographic and Optical Properties of Iodo-Succinimide.* **A. E. H. Tutton.** (Roy. Soc., Proc. 108. pp. 548–552, July 1, 1925.)—The X-ray research by Yardley [see preceding abstract] showed that a reinvestigation of the crystallographic and optical properties was necessary. The substance is very soft and fragile, and no cementing material has been found which does not act on it, so that it was necessary to use a grip holder in grinding instead of cement, and the grinding and polishing had to be carried out with great care to avoid slipping. The crystals are tetragonal, class 9, pyramidal polar (possessing only one symmetry element, the indispensable tetragonal axis of symmetry). This is one of the eleven enantiomorphous classes in which optical activity is possible. Ratio of axes $a : c$ (Yardley setting) $= 1 : 2{\cdot}471$. Two figures are given showing the crystal form corresponding to the new setting and to the old setting of Groth; many crystals have been seen which correspond fairly well with the first of these. The double refraction is negative; mean value 0·0237. The three thickest section plates showed brilliant colour in parallel light, under crossed Nicols, though no accurate determination of the angle of rotation could be obtained. This is probably due to repeated twinning of the two optical antipodes. This gave some curious effects in convergent polarised light. H. N. A.

2229. *The Principle of Relativity.* **W. F. G. Swann.** (Frank. Inst., J. 200. pp. 183–217, Aug., 1925.)—A brief account, of a somewhat non-technical character, is given of Einstein's special and general theories of relativity. J. S. G. T.

2230. *Apropos of Relativity.* **F. Prunier.** (Rev. Gén. d'Él. 18. pp. 107–110, July 18, 1925.)—The author replies to le Roux's criticism of Schwarzschild's derivation of the potential function in a gravitational field and discusses briefly the significance of aberration and the invariance of the Maxwellian electromagnetic equations. [See Abstract 1564 (1925).] J. S. G. T.

2231. *A New Discussion of Bucherer's Experiment.* **G. A. Schott.** (Phil. Mag. 50. pp. 389–399, Aug., 1925.)—A critical review of the work of Bucherer [Abstract 912 (1909)], Lewis and Doi [Abstracts 1562 and 1563 (1925)] indicates Doi's contention that Bucherer's results decide in favour of a mass-formula for the electron proposed by Doi and against that proposed by Lorentz to be definitely untenable. The discrepancy referred to by Doi is attributable to Doi's neglect to take account in his work of rays other than the compensated β-rays, *i.e.* rays for which the electric deflection neutralises the magnetic deflection. Moreover, Doi apparently does not compare calculated and observed deflections corresponding to the *same* ordinate of the film. To bring Doi's formula into approximate agreement with the results of Bucherer and Neumann it is necessary to assume that Bucherer over-estimated the intensity of the magnetic field employed by 30–40 % and of the electric field by 70–90 %. These errors are impossibly large, as the actual error in the former probably did not exceed 0·2 %. Experiments with improved apparatus are desirable to test the formulæ for values of β in the neighbourhood of and beyond the limit $\beta = 0{\cdot}85$. J. S. G. T.

2232. *The Effect of a Gravitational Field upon Electromagnetic Phenomena.* **W. Alexandrow.** (Phys. Zeits. 26. pp. 425–434, July 21, 1925.) —The work of Thirring [see Abstract 449 (1918) and *ibid.*, 22. p. 29, 1921] relating to the gravitational field of a sphere is extended and illustrated by examples in electrodynamics and with reference to the relativity of motion. [See Abstract 30 (1924).] J. S. G. T.

2233. *On the Objections of A. H. Bucherer and the Criticism of K. Popoff to the paper "Gravitation and the Principle of Action and Reaction."* **G. Maneff.** (Zeits. f. Physik, 33. 1–2. pp. 28–32, 1925.)—The author claims that his paper contains neither calculation errors, as Bucherer asserts, nor incorrect interpretation of the classical results, as Popoff maintains, but treats the subject from quite a valid yet different standpoint to theirs. In support he considers again the Maxwell-Lorentz electrodynamics applied to the gravitational field, discusses the problem of radial mass and radial velocity, and criticises Bucherer's standpoint as applied to his conclusions. [See Abstract 1572 (1925).] H. H. Ho.

2234. *Mechanics and the Einstein Invariance Principle.* **A. H. Bucherer.** (Zeits. f. Physik, 32. 11–12. pp. 894–906, 1925.)—The author has determined the mass of a light quantum in a gravitational field and obtained a relativity formula for mass [Abstract 821 (1923)] which was independently obtained [Abstract 2674 (1924)] from purely energetic and atomic structure considerations. From the later theory deductions are now drawn which find their complete satisfaction in a gravitational theory based upon extended but purely mechanical conceptions. These disprove the Einstein invariance principle, and with the disproof of this principle the author claims the Einstein gravitation theory is untenable. The paper is largely mathematical and the reasoning involved, and does not lend itself to brief abstraction. B. J. L.

2235. *An Elementary Deduction of Einstein's Law of Gravitation.* **T. Shimizu.** (Japanese Journ. Phys. 3. 7–10. pp. 187–195, 1924.)—Einstein's original treatment of the propagation of light in a gravitational field is briefly reviewed. This treatment affords a value of the deflection of a ray by the field which is half the observed value. The author shows that this discrepancy is attributable not to error in the assumptions made by Einstein, but in the mode of deduction of the result. The value of the interval, *ds*, in a gravitational field is deduced simply by a method based upon the special theory of relativity. J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

2236. *A Rain Gauge of Standard Commercial Materials and Parts.* **B. C. Kadel.** (Monthly Weather Rev. 53. pp. 66–67, Feb., 1925. Paper read before the Am. Meteorolog. Soc., Jan., 1925.)—The author describes in detail the construction of a rain gauge that can be made from standard commercial materials. By making the collector of the gauge 5·359 in. in diameter, one hundredth of an inch of rainfall is equivalent to one fluid dram in the gauge, and the measurements may be taken with a standard fluid measure. A. W. L.

2237. *On the Frequency of Occurrence of Dew and Hoar-frost.* **G. Hellmann.** (Meteorolog. Zeits. 42. pp. 257–260, July, 1925.)—Statistical summaries of these phenomena are difficult to prepare on account of difficulties of observation in or near towns, the late hour of observation (9 a.m.) and the large influence exerted by local topography on the formation of dew and hoar-frost. The records of two stations, Wasserleben and Hochheim, in north Germany, are examined in detail and a table of monthly frequencies prepared. Dew occurs most frequently in September, while from April to November, over fifteen and ten years respectively for the two stations, dew occurs on at least one day per month. The results obtained are compared with published values for other stations in Europe and elsewhere. In higher latitudes the number of days of dew decreases partly because of the lower vapour content. Finally a monthly frequency table for hoar-frost is given for six stations in Europe and one in South America. R. S. R.

2238. *The Meteorology of India.* **G. T. Walker.** (Roy. Soc. Arts, J. 73. pp. 839–849; Disc., 849–855, July 31, 1925.)—Some of the more important features of the climatology of India are discussed, and particularly the correlation of Indian rainfall with changes in the position of several centres of action. Diagrams illustrate the correlation coefficients obtained for several factors and the formulæ developed to predict the total rainfall for N.W. India or the peninsula. The Indian storm warning service and the application of rainfall data for precautions against malaria are considered. **R. Mant** raised the question of the conversion of large tracts of desert in the Punjab into cornfields by canal irrigation and the probable effect on the climate in these regions. **L. Rogers** dealt with the distribution of certain diseases in India in relation to the rainfall, humidity and prevailing winds. R. S. R.

2239. *The Acceleration of Continental Masses towards the Equator.* **R. Wavre.** (Arch. des Sciences, 7. pp. 163–186, May–June, 1925.)—The forces acting on a mass floating partially submerged on a fluid ellipsoid are considered. The method employed is to investigate the differential force between the immersed part of the continental mass and an element of sima of the same form. As an approximation the fluid pressures are considered the same in both cases. The case of an infinitely small element is succeeded by that of a vertical element of finite length but infinitesimal cross-section, and values for the resultant force towards the equator are given. It appears that the values will be between 1/8904 and 1/22606000 of the weight of the continental mass, with a probable value of about 1/753540. If the sima offered no viscous resistance to motion, the continental mass would be subject to a resultant acceleration towards the equator of 1/75 mm./sec./sec. This is at latitude 45°, the factor sin 2ϕ entering the expression. The end of the paper concerns itself with examining the order of the errors introduced by various approximations. A. Wh.

ASTRO-PHYSICS.

2240. *Ether Drift.* **F. Zerner.** (Comptes Rendus, 180. pp. 1903–1906, June 22, 1925.)—Ether drag may depend on two factors, either purely gravitational attraction or a kind of frictional effect. In the second case the deviation of a ray of light passing close to a star should depend whether it passes in the equatorial plane or close to the axis of rotation of the star. It is shown that there is possible evidence of an effect of this sort in the observed positions of the reference stars on the plates taken by Campbell and Trumpler of the solar eclipse of September, 1922. This shows up in two ways. Firstly the mean differences between the observed deviations and those calculated by distribution of the errors show a systematic effect, as would be expected if the ether were rotating, and its velocity of rotation decreases radially more slowly than $1/r^2$. Also the deviations appear to be less in the quadrants containing the equator than in those containing the axis. It is pointed out that the results of one series of measurements are not sufficient to prove an effect of this magnitude. A. Wh.

2241. *The Ballistic Theory of Variable Stars.* **M. la Rosa.** (N. Cimento, 2. pp. 159–169, April–May–June, 1925.)—A reply to a recent paper by Nordmann and le Morvan [Abstract 2036 (1925)]. These authors have objected that if the ballistic theory of variables is correct, the amplitude of the variation should be the same for all spectral regions. If I_a, I_b be constant components of the luminosity in two different spectral regions, i_a, i_b the variable components at minimum and m the factor giving the variable components at maximum, the ratio of the maxima and minima will be: $(I_a + mi_a)/(I_a + i_a)$ and $(I_b + mi_b)/(I_b + i_b)$, and in general these will not be identical if the components are of different sizes and temperatures. Objections by Salet are also dealt with. These concern the variations in radial velocity which would be expected on this theory. The discordance between data given by different investigators is noted. A. Wh.

2242. *Stellar Distribution in Space.* **K. G. Malmquist.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19a. No. 6. pp. 1–12, 1925. In English.)—If $a(m)$, $n(r)$ and F(M) are the frequency functions of apparent magnitude, distance and absolute magnitude, they may be related by the expression:

$$a(m) = \int_0^\infty dr \,.\, n(r) \,.\, \mathrm{F}\left(m - \frac{1}{b}\log r\right)$$

If $\mathrm{F}_m(\mathrm{M})$ is the frequency function of the absolute magnitudes of stars of a given apparent magnitude, a relation is obtained:

$$n_m(r) = \frac{1}{br}a(m)\mathrm{F}_m\left(m - \frac{1}{b}\log r\right)$$

which gives $n(r)$ by integration between $+\infty$ and $-\infty$. Application is made of these relations in the computation of the distribution in space of stars of spectral types B8 – A5 and between $6^m \cdot 25$ and $8^m \cdot 25$.
A. Wh.

2243. *Measurement of Star-cluster ICN* 4996. **W. Gyllenberg.** (Ark. f. Mat., Astron. och Fysik, Stockholm, 19a. No. 1. pp. 1–48, 1925. In German.)—This is a detailed account of the methods used in measuring four plates taken by Küstner at Bonn in 1919 and 1920. Table 17 is a catalogue of 105 stars belonging to the cluster, with their magnitudes and positions in right ascension and declination, and these positions are compared with the measurements of Bellamy and Burnham. M. A. E.

2244. *Problem of Stellar Evolution.* **H. N. Russell.** (Nature, 116. pp. 209–212, Aug. 8, 1925.)—The author reviews briefly the history of stellar evolution along two main lines, and the developments which led to Eddington's conclusion that the low surface temperatures of dwarf stars must be ascribed, not to low internal temperatures, but to the increase of opacity with density which prevents the heat from leaking quickly to the surface. The new theory indicates that a star of given mass (1) must be not far from a definite absolute temperature, but (2) may have any radius, surface temperature, and spectral type; but though (1) is confirmed by observation, (2) is in definite disagreement with the facts, since stars of a given mass (or absolute magnitude) are not indiscriminately distributed among the various spectral classes, and stars of not more than ten times the sun's luminosity lie chiefly between narrow spectral limits. From this view-point he divides the stars into three groups—the main sequence for which the luminosity diminishes rapidly and reddens; the giants; and the white dwarfs, which are more abundant per unit volume than any class except the K and M dwarfs. Eddington has shown that it is untenable that the rate of generation of a star's heat is independent of the internal conditions, and the author concludes that the rate of transformation of matter into energy increases with the temperature. On a figure showing the relations of twenty typical stars, he draws two sets of curves, computed from Eddington's theory [see Abstracts 1109 and 1730 (1924)], which represent stars of fixed mass and fixed central temperature, and shows that the main sequence stars have nearly the same central temperature of 30,000,000 degrees, the giants being cooler inside and the white dwarfs hotter. He follows the star's history from a sphere of rarefied gas, with a central temperature of a few hundred thousand degrees, to its birth, and traces the further course of its evolution, which is that: during the giant stage the surface temperature rises; along the main sequence it falls; and finally, when the star becomes a white dwarf, the temperature rises. The chief divergence from the earlier scheme is "that the diminishing in the dwarf series is due to decreasing mass and not to a falling off in compressibility." The difference of mass between giants and dwarfs is explained, and the white dwarfs find an orderly place at the end of the sequence. The youngest stars in the evolution are types N and Me; the latest, judging by the density, is the companion to Sirius. A. S. D. M.

2245. *Some Measurements of the Spectral Components of Planetary Radiation and Planetary Temperatures.* **W. W. Coblentz** and **C. O.**

Lampland. (Frank. Inst., J. 199. pp. 785–841, June, and 200. pp. 103–126, July, 1925.)—By transmission screens of water, quartz, glass and fluorite planetary radiation was separated into spectral components and radiation intensities determined in the spectral regions of $0\cdot3\mu$ to $1\cdot4\mu$, $1\cdot4\mu$ to $4\cdot1\mu$, $4\cdot1\mu$ to 8μ, 8μ to $12\cdot5\mu$ and $12\cdot5\mu$ to 15μ. Measurements were made on Venus, Mars, Jupiter, Saturn, Uranus, the Moon and on terrestrial sources. Radiation from Jupiter and Saturn transmitted by our atmosphere is very small; from Venus, Mars and the Moon relatively very intense. Measurements on Venus were made when the bright phase was a narrow crescent. Radiation from the dark part amounted per unit area to 10 % of the total radiation from the bright crescent. The southern hemisphere was hotter than the northern. The bright regions on Mars are cooler than the dark; the sunrise side cooler than that exposed to the afternoon sun; the polar regions emit no planetary radiation. The temperature of the irradiated surface was estimated as follows: (1) By direct comparison of the spectral components of planetary radiation from Mars and the Moon temperatures were obtained ranging from 5° C. for the bright equatorial regions to 20° C. for the adjoining dark regions; (2) by comparison with similar data calculated from the laws of spectral radiation from a black body temperatures ranged from − 15° C. for the bright to 12° C. for the dark regions; (3) by calculation using the fourth-power law of total radiation the temperatures were − 5° C. for the bright to 15° C. for the dark regions. When there was no phase on Mars the temperature of the east limb was − 45° C., of the west limb 0° C.; that of the north polar region in winter − 75° C., of the south polar region in early summer − 60° C. and in late summer + 12° C. The temperature estimates of the other planets are: Mercury, 75 to 100° C.; the upper limiting temperatures of the outer atmospheres of Venus, Jupiter, Saturn and Uranus, − 60°, − 75°, − 65° and − 75° C. respectively; the unilluminated face of the Moon, − 75° to − 200° C.

E. F.

2246. *The Sun-Clock.* **F. Hope-Jones.** (Journ. Sci. Instruments, 2. pp. 329–331, July, 1925.)—The instrument described consists of a sun-dial geared to the hands of a clock, and gives Greenwich mean time without observing a shadow or manipulating sliding scales. It is the invention of W. E. Cooke, Government Astronomer, Sydney, New South Wales.

AUTHOR.

2247. *The Physical Nature of the Solar Corona.* **W. Anderson.** (Zeits. f. Physik, 33. 4. pp. 273–301, 1925.)—In a previous paper [see Abstract 310 (1925)] the author has shown the solar corona to consist of neither solid nor liquid particles, but to be gaseous. K. Schwarzschild regards a corona of electronic gas as a very plausible assumption in many respects, although he experienced great difficulty in investigating its electrostatic characteristics. In the present investigation it is shown that while this difficulty is considerable, it is not insurmountable. Three other popular corona theories are also critically examined, from which the conclusion is drawn that these theories involve difficulties of like severity to those of the electronic gas theory. A continuance of work in other corona theories and the accumulation of fresh positive evidence in favour of the electronic gas theory is promised. H. H. Ho.

LIGHT.

2248. *The Reflection of Light by a Moving Mirror according to Classical Electrodynamic Theory and according to the Special Theory of Relativity.* **A. M. Titow.** (Zeits. f. Physik, 33. 4. pp. 306–319, 1925.)—The general case of the reflection of light at the surface of a perfectly reflecting mirror in motion in a moving medium is discussed mathematically, both in accordance with classical electrodynamic theory and with the special theory of relativity. The fact that the law of reflection at such a surface takes the same form according to either theory justifies the assumption either that the principles of classical electrodynamical theory and the two postulates of the special theory of relativity are not independent, or that these postulates are implicitly embodied in Abraham's deduction of the law of reflection. [See Abstract 2147 (1904).] J. S. G. T.

2249. *Stigmatic and Orthoscopic Corrections.* **C. W. van der Pijl.** (Rev. d'Optique, 4. pp. 229–251, May, 1925.)—The following subjects are discussed and mathematically treated: I. Transformation of Czapski's equations for the sagittal and tangential curves of the image. Conclusions. Spatial extension of the classical theory of focal distances. The image formed in the human eye and that produced by a photographic objective. Qualities and defects of these objectives. Want of plasticity. II. Orthoscopy and distortion. Wandersleb's theory and curves. Simplifications. Examples. III. Wave surfaces and caustic surfaces. Caustic poles and Gleichen's natural diaphragm. Examples. IV. Some appreciable qualities of the dioptrics of the human eye; the resulting visual image. Plasticity and stereoscopy. Spherical lenses do not admit of the construction of a photographic objective producing an image strictly comparable with the visual image, but methods of calculation permit an approximation within narrow limits. V. General method of calculation reducing tentative trigonometric methods to a minimum. Example for an objective approximating to the action of the human eye. The anastigmatic objective of the future. E. F.

2250. *Effect of Peripheral Illumination of the Retina on the Contrast Sensitivity of the Fovea.* **S. A. Emerson** and **L. C. Martin.** (Roy. Soc., Proc. 108. pp. 483–500, July 1, 1925.)—Forms a continuation of previous work on the photometric matching field [see Abstract 64 (1924)]. Measurements of the contrast limen for foveal vision were made (*a*) for a series of wave-lengths throughout the spectrum with a brightness of the central matching field equal to 0·079 millilamberts and a surrounding brightness of 0·04 millilamberts, and (*b*) for four wave-lengths with the same brightness of matching field as before, and for various surrounding brightnesses from 0 to about 0·2 millilamberts. The results are discussed by the light of the Young-Helmholtz theory and Allen's reflex theory. The curves connecting the contrast limen with the surrounding brightness all show an initial drop, followed by a rise. [The reference to Cobb's work on this subject, given on p. 499, should read June, 1913, and May, 1916.] J. W. T. W.

2251. *Absorption of Ultra-violet Light by Inorganic Halides.* **F. H. Getman.** (J. Phys. Chem. 29. pp. 853–864, July, 1925.)—In an improved apparatus, including a sector photometer developed by Judd-Lewis in conjunction with a Hilger quartz spectrograph, a large number of measurements are made of the extinction coefficients of the chlorides of Ca, Sr, Mg, Zn, Al, the results being tabulated. These salts are found to absorb ultra-violet radiation selectively, the wave-length corresponding to the head of the absorption band of each salt being approximately 273 $\mu\mu$. It is shown that the persistence of this characteristic absorption band throughout a series of chlorides cannot be attributed to the common ion Cl. Solutions of $CaCl_2$ are found not to follow Beer's law, from which it appears doubtful whether the law applies strictly to any strongly polar compounds. The molecular extinction coefficients of the metallic chlorides increase with the atomic weight of the combined metal. Every metallic chloride thus far examined exhibits either selective or general absorption. A. B. C. L.

2252. *The Transformation of Trichromatic Mixture Data: Algebraic Methods.* **J. Guild.** (Optical Soc., Trans. 26. 2. pp. 95–104; Disc., 105–108, 1924–1925.)—The paper describes algebraic methods of transforming colour-mixture equations from one trichromatic system to another. The procedure suggested differs from that previously described by H. E. Ives, and effects important simplifications in the work involved in its practical application to various problems. In particular it is shown how measurements made in terms of the arbitrary working primaries of any trichromatic colorimeter can be transformed into any system of standard primaries, or *vice versa*, without auxiliary measurements other than can be made on the instrument itself used in its normal manner. AUTHOR.

2253. *An Equipment for Visual Spectrophotometry.* **J. Guild.** (Optical Soc., Trans. 26. 2. pp. 74–94, 1924–1925.)—The paper describes the equipment for visual spectrophotometry designed by the author and installed in the Optics Department of the National Physical Laboratory. The chief features of the equipment are as follows: (1) High light efficiency is obtained by omitting all unnecessary optical parts from the test beam and having independent slit width adjustment for the comparison beam to compensate for the necessary minimum absorption of the measuring apparatus. (2) The basis of measurement is Talbot's law as applied to rotating sectors. A method of employing a series of sectors is described which enables the whole range of effective transmission from 100 to 0·01 % to be covered by a series of fixed points, each of which corresponds to a transmission about 90 % of the next higher, with only a few sectors, none of which is below 1 %, in its effective transmission. A convenient method of calibrating the small-angle sectors is also described. The gaps between the fixed points obtainable by the use of the sector equipment are covered by photometric wedges which are calibrated in terms of the sector disks. (3) The field of the instrument is of the Lummer-Brodhun contrast pattern, which possesses important advantages for spectrophotometry. (4) Adjustments are incorporated which eliminate errors due to lack of accurate parallelism in the specimens tested.

AUTHOR.

2254. *Note on the Calculation of Aplanatic Triple Objectives of Equal Interior Curvatures.* **H. L. Tardy.** (Rev. d'Optique, 4. pp. 305–310, June–July, 1925.)—H. Harting (1900) has proposed general formulæ

for the algebraic calculation of triple objectives which, however, are unsymmetrical and inconvenient. The present mathematical paper removes these defects and separates the terms which relate to size from those which are functions of the glass. Generalisation of the results to objectives of the same type but formed of any number of lenses is included.
H. H. Ho.

2255. *Theodolite with Distance-measuring Attachment.* **E. Hammer.** (Zeits. Instrumentenk. 45. pp. 353–358, July, 1925.)—Describes a theodolite constructed by H. Wild, of Heerbrugg (Switzerland), on the lines of the new Zeiss theodolite [see Abstract 1061 (1925)]. A full description is given of a distance-measuring attachment which is fitted to the telescope objective, and the movable part of which consists of two plane parallel glass plates rotated in opposite senses about a common axis. The degree of rotation gives the distance of the surveying scale viewed. J. W. T. W.

2256. *Arrangement for Measuring Optical Constants of Crystals in the Ultra-violet.* **P. Sève.** (Comptes Rendus, 180. pp. 1951–1952, June 22, 1925.)—Since glass and Canada balsam absorb ultra-violet light, the apparatus is constructed with lenses and prisms of quartz and Foucault polariser and analyser. The achromatic lenses required are made of quartz and Iceland spar or quartz and fluorspar. Various observations have been made in the ultra-violet on calamine, which is transparent up to about $0 \cdot 24\ \mu$, and cerusite transparent up to about $0 \cdot 29\ \mu$. H. N. A.

2257. *The New Electro-Microphotometer of the Tübingen Observatory (Oesterberg).* **H. Rosenberg.** (Zeits. Instrumentenk. 45. pp. 313–333, July, 1925.)—In order to compare the brightness of stars from the light effects on photographic plates astronomers have hitherto made extensive use of the Hartmann microphotometer [see Abstract 1660 (1899)], whose efficiency limits depend on the eye. This instrument is discussed at length, with its limitations. A new electro-photometer is then described whose leading characteristic is the use of the photo-cell exclusively as a null instrument, whereby the highest accuracy may be attained. Very full and complete details are given with diagrams and data, for which the paper itself must be consulted. The utility of this new electro-microphotometer is illustrated by numerous examples taken from normal dark photometry and from spectral line work. H. H. Ho.

2258. *Calcspar Lenses as Polarisers.* **H. Schulz.** (Zeits. f. Physik, 33. 3. pp. 183–184, 1925.)—A brief note in extension of the publication [Abstract 2067 (1925)] of details of a patent for the use of calcspar lenses for the production of intense polarised light. The value of the system in actual practice is discussed and the effects of corrections for aberration, etc., and the methods of effecting the same are noted in detail. S. G. B.

2259. *The Principles and Construction of the Telephotographic Lens.* **H. W. Lee.** (Phot. J. 65. pp. 392–402, Aug., 1925.)—The author in some preliminary remarks points out that the name " telephoto " is misleading, as the sole point of difference between the telephoto and any other lens of the same focus lies in the shorter back focus. With the aid of an explanatory diagram he explains the formulæ essential to the user of variable magnification telephoto, including those for the telephoto effect, optical interval, and separation of planes. This is followed by an account of the earlier telephoto lenses of Dallmeyer, Voigtlander, Zeiss, Goerz, Steinheil and others, leading up to a description of the more recent telephoto combinations of Booth, Lee, Zeiss, Ross, Rudesdorp and others. Sectional illustrations of typical lenses are included. A number of aberration curves of telephoto lenses, showing axial and field corrections and distortions, is also given. A. W. J.

2260. *Some Applications of the Telephotographic Lens.* **E. Marriage.** (Phot. J. 65. pp. 402–405; Disc., 405–406, Aug., 1925.)—A short account, illustrated with photographic reproductions, is given showing the application of telephotography to the photographing of architecture from distant points, to mountain scenery, water flora, and natural history subjects. A. W. J.

2261. *A New Semi-automatic "Entzerrung" Arrangement for Topographical Use.* **C. Aschenbrenner.** (Zeits. Instrumentenk. 45. pp. 333–353, July, 1925.)—By "Entzerrung" is understood an optical transformation of the original survey which shows a central perspective with inclined image plane, into a central perspective with horizontal image plane. In this paper the theoretical basis is discussed at length, and a full description of the apparatus is given with a diagram and photographs illustrating it. The theory of the sources of error is fully dealt with. A. E. G.

2262. *Stress Optical Coefficients of Glass for Direct Tension and Pressure.* **S. R. Savur.** (Phil. Mag. 50. pp. 453–463, Aug., 1925.)—The results obtained with various specimens of glass subjected to tensions and pressures up to about 280 kgm. show that, within the limits of error, the law connecting double refraction and stress is accurately linear and the same for tension and pressure. There is no indication of any departure from this law for small loads, as suggested by Wertheim. One specimen of glass showed a numerical increase of the stress optical coefficient from the violet towards the red. Some results previously given by Filon suggest that this could only occur for quite a small range of composition. A. W.

2263. *Application of the "Moiré" to the Study of Mica Deformations.* **M. Mulot.** (Rev. d'Optique, 4. pp. 252–259, May, 1925.)—A theoretical study of the moiré fringes obtained with a wedge formed of wire gauze and a plane diffusing surface; application of these fringes to the study of a deformed surface. The results obtained with a thin plate of mica are found to bear a relation to certain of its mineralogical properties. Further experiments established the isotropy of paper and the anisotropy of cellophane. Though giving only qualitative results, this method will be of service in the study of surface symmetry. Mainly mathematical. E. F.

2264. *Influence of Solvents on Rotatory Power.* **R. Lucas.** (Comptes Rendus, 181. pp. 45–47, July 6, 1925.)—It was found that the specific rotation of the alkyl camphors varied with different solvents, and an explanation was put forward to explain the phenomenon. The dissolved substance is capable of assuming two distinct molecular forms, each possessing a definite rotatory power and dispersion. Under the action of different solvents, the relative proportions of these two forms is variable, and for each there is a condition of equilibrium at each concentration and temperature. The behaviour of camphor in benzene and cyclohexane solution and mixtures of the two solvents supported the conclusions. F. J. B.

2265. *Diffusion of Light and the Kerr Constant.* **R. de Malleman.** (Comptes Rendus, 180. pp. 2035–2037, June 29, 1925.)—The Tyndall and the Kerr effects are, according to the theory of molecular orientation, a direct consequence of the anisotropy of the molecules, and thus is afforded a method of establishing a relation between these two quantities. Gans has already indicated the existence of such a relation in the case of gaseous molecules possessing a principal axis of symmetry. In the case of liquids Gans considers the molecular theory insufficient, and has developed [Abstract 2405 (1923)] a thermodynamical theory for the Kerr-effect which leads to an expression involving the value of the depolarisation factor for the liquid ϕ_1 as a function of the Kerr constant. Gans characterises his result as a decisive argument for the thermodynamical theory, and further employs it to explain difficulties of interpretation of experimental results observed by Raman and Ramanathan. The present paper contends that Gans' arguments are unsound, and it is shown mathematically that the molecular theory can be utilised to lead to the same conclusion as the thermodynamical theory. This is fully treated and discussed. S. G. B.

2266. *Optical Interference Experiments with Multiple Sources.* **J. J. Dowling** and **J. A. C. Teegan.** (Phil. Mag. 50. pp. 341–344, July, 1925.)—The usual biprism method yields only two sources. By the use of further prisms the number of sources may be increased. The fringes obtained with two biprisms, and therefore four sources, are shown photographically. There is a discussion of the dependence of the illumination curve on the number of sources. A. A. D.

2267. *Optical Interference Experiments and the Compton Shift.* **S. J. Wawilow.** (Phys. Zeits. 26. pp. 468–469, July 31, 1925.)—A theoretical and mathematical discussion of the theories of Compton and Debye in connection with Newton's postulate that reflection and refraction do not change the colour of simple light. Interference experiments lead to the conclusion that this postulate holds good to within about 10^{-4} Å. [See Abstracts 1878, 2194 (1923) and 130 (1925).] E. F.

2268. *The Scattering of Light by Liquid Boundaries and its Relation to Surface-Tension. Part I.* **C. V. Raman** and **L. A. Ramdas.** (Roy. Soc., Proc. 108. pp. 561–571, Aug. 1, 1925.)—Hardy and Langmuir's conception that the surface-tension is determined by a layer of orientated molecules which forms the boundary of a liquid raises the questions as to whether this layer should not be doubly refractive. Further, in what manner would thermal agitation influence the configuration of molecules in this boundary layer, and how is it related to surface energy of the fluid ? Is the surface layer capable of producing by external or internal change the observed elliptic polarisation of light reflected by liquid surfaces at the Brewsterian angle ? The paper is an experimental attempt to solve these questions. Details of the careful preparation of clean surfaces are given, and the intensity of the light scattered by the mercury surface is measured by comparison with plaster of Paris and black varnish surfaces under standard conditions. A clean mercury surface illuminated normally with unpolarised light in the green part of the spectrum and viewed at 45° has only $5 \cdot 7 \times 10^{-7}$ times the brightness of a plaster of Paris surface under the same conditions. It is found that perfectly clean liquid surfaces, under strong illumination, scatter light appreciably in all directions, the effect being probably due to the irregularities of the surface resulting from thermal agitation as controlled by the surface tension of the fluid. Detailed descriptions are given of the effects observed in respect of the polarisation and distribution of intensity of the scattered light in different directions. Observations were also made with clean surfaces of molten sodium *in vacuo*, obtained by electrolysis through glass, with the result that the phenomena observed in the case of mercury were repeated more conspicuously. S. G. B.

2269. *Studies in Photographic Sensitivity.* (4) *The Formation of the Latent Image.* **S. E. Sheppard, A. P. H. Trivelli** and **R. P. Loveland.** (Frank. Inst., J. 200. pp. 51–86, July, 1925.)—The previous three papers dealt with various hypotheses, with special reference to statistical variation of sensitivity among the silver halide grains of an emulsion, with the effect of light in bringing about developability closely imitated by the action of hydrogen peroxide and with the action of a desensitiser such as chromic acid, which was shown to destroy the pre-existing " specks " or nuclei, which are not silver bromide. The present paper deals with the part played by these " specks " amongst the grains in the formation of the latent image. [See Abstracts 1157 (1924) and 549, 550 (1925).]
A. W. J.

2270. *Photographic Gelatin.* **S. E. Sheppard.** (Eastman Kodak Co. Research Lab., Comm. No. 240. Phot. J. 65. pp. 380–387, Aug., 1925.) —This paper describes the results of the author's investigations at the Eastman Research Laboratories in America. He points out that previous investigations had indicated that the sensitivity of gelatino-silver bromide emulsions was due in a large measure to the presence on or in the grains of traces of some substance other than silver bromide. The nature and mode of action of the substance forming so-called " sensitive centres " have, however, remained a mystery until recently, when, owing to the publication of patents covering the industrial applications, the results of the author's researches became available. The available information indicates that the enhanced sensitivity of high-speed emulsions is primarily due to small chemical differences in gelatins not affecting the grain size distribution. The " sensitivity centres " are due to the gelatin. This sensitising property of certain gelatins has been traced to the presence of very small traces of organic *isothiocyanates* (thiocarbimides) and thiocarbamides, and specifically allyl mustard oil and allyl thiourea. The *thiocarbamides* interact with the silver halides, forming nuclei of *silver sulphide,* which is the material of the " sensitivity centres." Silver *selenide* and *telluride* also function equivalently. This result is shown to be in harmony with the " orientation " theory of photographic sensitivity already proposed by the author and collaborators. [See Abstract 1124 (1923).] A. W. J.

2271. *Photographic Photometry.* **J. Flügge and W. Ewald.** (Zeits. f. Physik, 33. 4. pp. 325–332, 1925.)—Gives a theoretical outline of a method of heterochromatic photometry by the use of photographic plates of known gamma and known spectral sensitivity exposed through neutral wedges to give regions of equal blackening. J. W. T. W.

2272. *Heterochromatic Photometry.* **W. Ewald.** (Zeits. f. Physik, 33. 4. pp. 333–334, 1925.)—Gives a description of a proposed method for heterochromatic photometry. If it be desired to measure a green light by comparison with a white standard, a standardised lamp and filter giving the complementary red light is caused to illuminate the side of the photometer disk illuminated by the unknown green. The proportion of the two colours is adjusted to give a match with the standard white, and the comparison is then homochromatic. J. W. T. W.

2273. *Observations of Spectro-photometric Measurements of Paint Vehicles and Pigments in the Ultra-violet.* **G. F. A. Stutz.** (Frank. Inst., J. 200. pp. 87–102, July, 1925.)—In determining some properties of white pigments in the ultra-violet spectrum, Pfund (Am. Soc. Test. Materials, Trans., 1923) has demonstrated the opacity of some materials and the transparency of others. The present investigation extends this work and considers: (1) A determination of the absorption coefficients of various paint vehicles in the ultra-violet spectrum; (2) a determination of the reflection coefficients of various paint pigments in the ultra-violet spectrum; (3) a determination of the effect of light on paint films made up of some of the pigments measured. Apparatus details, comprehensive data tables and fifteen curves are included. H. H. Ho.

2274. *Structure of Band-Spectra.* **H. Deslandres.** (Comptes Rendus, 180. pp. 1980–1986, June 29, 1925.)—The theory developed in the previous paper [see Abstract 2085 (1925)] is here applied to the infra-red band-spectrum of water-vapour. In addition it is shown that the secondary maxima of the $6{\cdot}26\ \mu$ band can be represented by the formula $\nu = 1597 + t \times 22{\cdot}135$, where t has all values from 1 to 24. F. S.

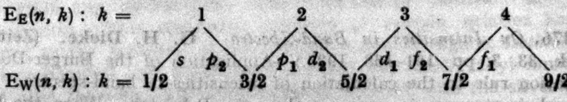
2275. *Structure of Band-Spectra.* **R. Mecke.** (Zeits. f. Physik, 32. 11–12. pp. 823–834, 1925.)—Some of the material collected in a recent paper [see Abstract 1369 (1925)] is considered in greater detail. Of sixteen accurately analysed spectra it is shown that there is a relation between the oscillation energy of the nucleus and the rotational energy, which throws light on the structure of the atom. In the case of the band-spectra of N_2 and O_2, in which there are intensity anomalies, it is likely that lines of increased intensity belong to one series. F. S.

2276. *On Intensities in Band-Spectra.* **G. H. Dieke.** (Zeits. f. Physik, 33. 3. pp. 161–168, 1925.)—Application of the Burger-Dorgelo summation rule to the calculation of intensities in band-spectra. The P-branch is stronger in emission than the R-branch. When the band consists of real simple lines the course of the intensity is not the same as when it is formed of unresolved doublets. A simple mode is indicated of explaining the alternating intensities observed in many bands. The treatment is mathematical. E. F.

2277. *Enhanced Lines of Various Elements.* **M. Kimura** and **G. Nakamura.** (Japanese Journ. Phys. 3. 7–10. pp. 197–215, 1924. In English.)—Enhanced lines of tin have previously been classified by comparing the lengths and rates of diminution of the intensities of lines emitted just in front of the kathode of a Geissler tube provided with a tin kathode and salt anode [see Abstracts 861 and 862 (1925)]. In the present paper this method has been used for other metals, the results being compared with those of Lockyer and the work of Fowler and Paschen on Si IV and Al III respectively. Results are given for Sn, Na, Mg, Al, Si, K, Ca, Cu, Zn, Sr, Ag, Cd, Sb, Ba, Hg, Pb and Bi. F. S.

2278. *Enhanced Lines of Various Elements.* **M. Kimura.** (Japanese Journ. Phys. 3. 7–10. pp. 217–225, 1924.)—A method of increasing the arc length and hence the potential difference, so that lines due to higher stages of ionisation are excited, is described. It consists of an intermittent arc formed between a pole of the element and a disk with the edge cut like a gear-wheel. This disk is rotated about a horizontal axis at a rate of about 1000 revs. per min. A condenser of suitable capacity is shunted across this arc, when the flame disappears and the arc takes on the appearance of a spark with a crackling sound. Results are given for Sb, Bi, Pb, Sn, Al, Zn, and Cd. Only spark lines were found in an interrupted arc without condenser, but super-spark lines were developed as the voltage increased from 110 to 440 volts, when a condenser was used. F. S.

2279. *The Quantum Theory of the Structure of Multiplets and of the Anomalous Zeeman Effect.* **W. Heisenberg.** (Zeits. f. Physik, 32. 11–12. pp. 841–860, 1925.)—The author considers the reciprocal double relation or action between the radiating electron and the rest of the atom—a relation which cannot be described mechanically—and arrives at a new formulation. Many empirically found regularities in the multiplets of higher order are thus explained, and the selection rules for simultaneous springs of several electrons are investigated in terms of the correspondence principle. The reciprocal double relation mentioned above is such that each definite given stationary state of the outer electron and the rest of the atom has always two different energy values of reciprocal action corresponding to it, with two different stationary states of the combined atom, and that conversely for every value of the energy of reciprocal action there are always two systems of stationary states of the electron and of the rest of the atom. There is thus a characteristic dualism in the model-like imagery made use of in developing the theory. The following is the scheme for the relation between the proper energy, $E_E(n, k)$, and the energy of reciprocal action, $E_W(n, k)$, in the case of a doublet atom, showing that to each value of the proper energy correspond two values of $E_W(n, k)$:



$E_E(n, k)$: k = 1 2 3 4
s p_2 p_1 d_2 d_1 f_2 f_1
$E_W(n, k)$: k = 1/2 3/2 5/2 7/2 9/2

Similar schemes are developed for other cases. H. N. A.

2280. *On the Doublets and Triplets in the Spectra of Different Elements.* **Y. Sugiura.** (Japanese Journ. Phys. 3. 7–10. pp. 155–185, 1924. In

English.)—The object of the paper is to calculate the frequency differences of the doublets in the p terms of the alkali metals, Cu and Ag, and those of the triplets of the elements in the second column of the periodic table, by taking into account the atomic field due to the electron orbits. The magnetic moments of the atom may be considered as separated into two parts, one of which corresponds to the valence electron and the other to the atom body; and when there is only one electron these two parts may either be in the same or in opposite directions, the result being that there are two resulting vibration frequencies or a doublet. When there are two valence electrons the moments corresponding to the atom body and to the two valence electrons may be all in the same direction; the electron moments may be in the same direction and that of the atom body opposite, or the moment of one electron may coincide with that of the atom body and that of the other be opposite to it. The result would be a triplet. The intra-atomic magnetic field due to elliptic electron orbits is calculated, and expressions are obtained for the differences of wave numbers in doublets and triplets. In the case of the doublets the calculated values agree well with those observed; this includes Al, Ga, Ir and Tl. The wave number differences for the triplets are also discussed, and the calculated are compared with the observed values. H. N. A.

2281. *Intensities of Lines in Multiplets. Part I.* **H. N. Russell.** (Nat. Acad. Sci., Proc. 11. pp. 314–322, June, 1925.)—Theoretical expressions are obtained for the intensities of lines in various groups of multiplets in terms of the quantum numbers used by Landé. The expressions found are compared with similar ones obtained by Ornstein and Burger. The paper is mathematical, and does not readily admit of abstraction. F. S.

2282. *Intensities of Lines in Multiplets. Part II.* **H. N. Russell.** (Nat. Acad. Sci., Proc. 11. pp. 322–328, June, 1925.)—The theory developed in the previous paper [see preceding Abstract] is here compared with observed data. A comparison of observed and computed values is given for a triplet system in which case a few precise measures are available. King's data on arc and furnace spectra have also been used to compile a comprehensive table of such comparisons, from which agreement with theory is seen to be as good as might be expected. In a note the author points out that Sommerfeld and Honl have obtained substantially identical formulæ, and suggests that this comparison will serve for both investigations. F. S.

2283. *The Intensity of Multiple Lines and their Zeeman Components. Part II.* **R. de L. Kronig.** (Zeits. f. Physik, 33. 4. pp. 261–272, 1925.) Continuation of a previous paper [Abstract 1879 (1925)]. Making use of the new views of Heisenberg, and of the author's formulæ for the intensities in multiplets of the first order, the intensity relations in normal multiplets of higher orders are dealt with on the correspondence principle, and it is shown why it is possible to extend the use of these formulæ to such multiplets. It is found that in multiplets of higher order the intensities can be expressed by means of the formula given in Part I if K is replaced by the quantum number L used by Heisenberg in classifying the terms as $s, \bar{s}$; $p, \bar{p}$; $d, \bar{d}$; and which, when $s, \bar{s} = \frac{1}{2}$, $p, \bar{p} = \frac{3}{2}$, $d, \bar{d} = \frac{5}{2}$, is not the impulse of the photoelectron, but the formal combined impulse of the electrons which are mutually quantified, but do not form a closed group.

An attempt is also made to determine a connection between the magnitude of the multiplet interval and the occurrence of disturbances, and in particular of intercombinations, as a result of which a simple generalised application of the formulæ becomes possible. The results yield an explanation of different features in complicated spectra, and appear also to agree with Dorgelo's measurements of intensity in the neon spectrum. H. N. A.

2284. *Spectra resembling that of Hydrogen and the Capacity for Polarisation of the Trunk of the Atom.* **E. Schrödinger.** (Ann. d. Physik, 77. 1. pp. 43–70, June, 1925.)—The capacity for polarisation, P, of atomic trunks which have the structure of the inert gases, such as the neon trunk of Na I, Mg II, Al III and Si IV, is calculated from the respective *p*-, *d*- and *f*-series. Within the same series it is found in many cases to be very nearly constant, but varies from series to series of the same spectrum. In the above spectra P is from three to five times as large for the *d*-series as for the *f*. The author concludes, in agreement with Hartree, that the idea of a constant P in the case of the outer orbit series is on the whole not far from the truth. The fact that some of the outer orbits of Li and Na appear to be more loosely bound than on the assumption that all the electrons of the trunk are united with the nucleus may be a real one, and not due to the use of inaccurate values of the terms in question. The remarkable disturbance in the Bergmann series of Al II discovered by Paschen may be explained as being due to resonance of the trunk at a certain frequency, P being very large just below this frequency and negative above it. In the arc spectra of the alkaline earths the relations are not so simple, and the explanation given for the behaviour of Al II must be taken with a certain reserve. The question of whole quantum numbers is discussed, as compared with those differing from whole numbers by $\frac{1}{2}$, and in this connection the relation between P and the optical refractive index is considered. H. N. A.

2285. *Maximum Excitement of Spectrum Lines in a Layer of the Positive Hydrogen Column.* **E. Lau.** (Ann. d. Physik, 77. 2. pp. 183–194, July, 1925. From the Reichsanstalt.)—A record of experimental observations, of which full details are given. The Balmer lines and the Fulcher bands lie at different points in the layer, and in the latter case least electron velocity is related to lines of least wave-length. The maximum of the continuous spectrum lies between 5000 Å.U. and 4000 Å.U. A small fall of potential results in an alteration of the point of maximum intensity within the series. Electron velocity is alterable with a potential change of 1 volt, and according to the kind of layer such alteration may result in either electronic acceleration or retardation. The maxima were also investigated in a double layer, and it was found that the Balmer series and Continuum gave two maxima, whilst the Fulcher bands gave only one. The paper hints at the possibility of electrons existing in the layer which have velocity greater than those excited in the positive column. S. G. B.

2286. *Some Remarks on the Fulcher Hydrogen Bands.* **G. H. Dieke.** (Phil. Mag. 50. pp. 173–179, July, 1925.)—Several papers have appeared recently which deal with the regularities in the secondary spectrum of hydrogen discovered by Fulcher in 1912. Most of the interpretations agree in principle with the one given first by Lenz, but differ in detail among themselves. In an earlier paper [Abstract 560 (1925)] the author showed that there is another possibility of explaining the regularities which gives quite different results regarding the structure of the molecule. The paper consists of a comparison of the two possibilities. The two interpretations are: (1) That the "horizontal series" form a band; (2) the "vertical series" are branches of a band. The interpretation (2) is preferred on the grounds of the existence of formulæ of the type $\nu = \mathrm{A} - \mathrm{C}m'^2 - \mathrm{D}m'^4 (m' = 1\cdot5\,;\ 2\cdot5, \ldots)$, expressing the lines of a vertical series. The structure of one band is not one familiar to us from other band-spectra, and only further experimental investigation can solve the problem with certainty. We expect in hydrogen that the first or second line will have the maximum intensity at ordinary temperatures and each band will contain only a few lines. Accepting interpretation (2), the conclusion is reached that each vertical series consists in reality of two different series, a strong one and a weak one, the odd lines corresponding to transitions $m - \frac{1}{4} \rightarrow m - \frac{1}{4}$, and the even lines to $m + \frac{1}{4} \rightarrow m + \frac{1}{4}$. Quarter effective quantum numbers have been found to exist in almost all bands which must be attributed to pure elements. Considerations of temperature distribution of intensity also support assumption (2). The value of the moment of inertia is given as $0\cdot82 \times 10^{-40}$. W. V. M.

2287. *Problems of the Auroral Spectrum.* **J. C. McLennan** and **G. M. Shrum.** (Roy. Soc., Proc. 108. pp. 501–512, July 1, 1925.)—A hitherto unknown line ($\lambda = 5577\cdot35 \pm 0\cdot15$ Å.), which is very sharp and is subject to great fluctuations in intensity, has been found in studying the effect of large admixtures of helium or of neon on the spectrum of oxygen. The line is not a limiting member of the ordinary band-spectrum, but must be attributed to some hitherto unknown spectrum of oxygen. It has been observed faintly in highly purified oxygen when currents of high density were used. Evidence is produced to identify the line with the auroral green line $\lambda = 5577\cdot350 \pm 0\cdot005$ Å. By exciting mixtures of helium, oxygen and nitrogen the line 5577 could be photographed on the same plate with the nitrogen band system, thus reproducing in the laboratory practically the entire auroral spectrum. The possibility of metastable helium acting as the exciting agent in the auroral spectrum is discussed. Clear reproductions of the new line are given. W. H. Ge.

2288. *Structure of the Band-Spectrum of Helium. Part III. The Doublet Bands.* **W. E. Curtis** and **R. G. Long.** (Roy. Soc., Proc. 108. pp. 513–541, July 1, 1925.)—In a previous paper [Abstract 1856 (1923)] an account was given of a preliminary study of the helium bands. By the use of a large Littrow-type spectrograph and carefully prepared silica discharge tubes five more members of the main series have been photographed and measured. No further members of the second series were observed. Previous difficulties of interpretation have been overcome by employing a non-integral quantum number $(m - \epsilon)$; by forming suitable combinations all the rotation terms, both initial and final, can then be evaluated. For the earlier bands ϵ comes out $\pm \frac{1}{2}$ within the limits of error, but it departs from this value in the initial terms of the higher members of the series, except in the case of the Q branches, where it remains constant at $\frac{1}{2}$. The bands are capable of very accurate representation by the addition of a term $\beta(m - \epsilon)^4$ to the usual parabolic formula, and this leads to new and much more accurate values of the molecular moments of inertia and separation of the nuclei. This information, in conjunction with deductions concerning the electron orbits, has an important bearing on the question of the structure of the helium molecule, and affords support to Lenz's suggestion that its structure may be related to that of the hydrogen molecule. The new methods also throw light on the nature of the perturbations occurring in two of the bands. The second series of doublets has been re-examined, and although the data are much less extensive, the results of the analysis are closely similar to those obtained from the main series. It is concluded that the two series must originate from the same molecule but a different radiating electron. Attention is directed to several features for which the theory does not at present appear to provide an explanation. A. W.

2289. *On the Total Strength of the Absorption Lines proceeding from one State.* **W. Kuhn.** (Zeits. f. Physik, 33. 5–6. pp. 408–412, 1925.)—On the assumption of extensive validity of the hypotheses of the classical dispersion theory, a quantum summation law has been formulated wherein the total intensities of the lines comprised in an absorption range stand in relation to the number of electrons, which, with all the essentially dependent transition processes, are connected with the known absorption range. H. H. Ho.

2290. *Electromagnetic Sensitivity of the Iodine Atom.* (*Intensity Changes in the Line Spectrum.*) **W. Steubing.** (Zeits. f. Physik, 33. 1–2. pp. 113–127, 1925.)—Arc and spark lines of the iodine atom exhibit quite different behaviours in the magnetic field. The former are fairly sharp and remain so, but change their relative intensity to each other; the latter are for the most part strongly broadened and appear accompanied by components, while under the action of the magnetic field the lines are essentially less sharp. In the spectrum of the neutral and simply ionised atom new lines appear when the magnetic field is imposed. A Zeeman effect was not observed. The lack of sharpness in the spectrum of the condensed spark depends strongly on the iodine vapour-pressure, and only for quite low pressures is the sharpness sufficient for exact investigation. Since this characteristic can be connected with the molecular Stark-effect, additional gases were used. Mixtures of pure iodine vapour with argon, helium, neon, air, nitrogen, oxygen and hydrogen showed that the intensity of the iodine spectrum is the more strongly suppressed the higher the molecular weight and the chemical affinity of the added gas. The smallest diminution of intensity was by addition of helium-neon present. By addition of helium-neon mixture of definite partial pressure various faded lines can be resolved into separate components. Moreover, single intensive new iodine lines occur, which under the same conditions cannot be obtained without additions, and which are explained by indirect energy transference by impacts of the second order. H. H. Ho.

2291. *The Regularities in the Resonance Spectrum of Iodine Vapour and the Determination of Moments of Inertia.* **A. Kratzer** and **E. Sudholt.** (Zeits. f. Physik, 33. 1–2. pp. 144–152, 1925.)—The iodine resonance spectrum has become of special interest through the work of Lenz [see Abstract 2502 (1924)], claiming to afford a proof for the Heurlinger-Lenz theory of band-spectra. Opposed to this, Mecke has submitted a series of regularities which are not explained by it. The author now supplies the defect by a determination of the resonance spectrum of a molecule from the term formula of the band-spectrum, and in particular discusses the dependence of the position of the re-emitted lines on the oscillation quantum number. The observations of excited iodine resonance by the green Hg-line show agreement with the theoretical formula. The calculation of the moment of inertia of the iodine molecule, with an empirical error of possibly 10 %, gives $8 \cdot 6 \times 10^{-38}$ g.cm.^{2}. H. H. Ho.

2292. *On the Behaviour of some Spark Lines of Carbon in an Electric Field.* **S. Nakamura** and **Y. Fujioka.** (Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 34. pp. 155–161, July, 1925. In English.)—Observations were made to find the nature of the effect produced by an electric field on Fowler's carbon line λ4267, which is really a close doublet, λ4267·27 and λ4267·02, and on other carbon lines. With the available apparatus, which gave a field of about 100 kv.cm. and from 5 Å. to 5·3 Å. per mm. on the photographic plate, it was not possible to resolve the doublet with transverse observation, but the line was broadened, the amount depending mainly on the strength of the field and not on the pressure of the helium with which the discharge tube was filled. The distribution of intensity in the broadened figure is fairly uniform, and the light is not polarised. With longitudinal observation upon the heterogeneous field in the dark space λ4267 splits up into two components, the separation being consistent with the supposition that the emitting sources are single carbon atoms with unit charge, which have fallen through 5000–6000 volts, the p.d. between the terminals. A curious effect of broadening was observed with oblique observation. Owing to the Doppler-effect it was not possible to decide whether the broadening was due to a Stark-effect of an extraordinary nature or not. H. N. A.

2293. *Spectrophotometry of the Glow Discharge.* **R. Seeliger** and **W. Lindow.** (Phys. Zeits. 26. pp. 393–403, June 30, 1925.)—In the continued researches [Abstract 2827 (1924)] the intensity of sections of the dark kathode space is determined by taking series of spectrograms with circular stops of varying apertures inserted behind the prism. The kathode of aluminium is cooled by flowing water; the anode is of copper; the former electrode, sometimes also the latter, is mounted in a ground-in section of the tube. Experiments are made in oxygen and in hydrogen at pressures of the order of 1 mm. In oxygen the dark space is red-violet, the glow yellow-white and the positive column yellow-green. In the negative glow of oxygen the three spectra (series, spark, ozone) are represented with fairly equal intensity. The intensity curves taken at different distances from the kathode show that the apparently sharp boundary of the negative glow is only subjective, and this is confirmed by the use of coloured filters. The first kathode layer (close to the kathode) seems due to the impact of canal rays and not to slow electrons from the kathode. The tube remaining cold, the length of path of the electrons was probably inversely proportional to the gas-pressure. The general diminution of the glow intensity in the negative column is determined with the aid of a sensitive Gehlhoff-Schering photometer; the kathode was made movable in these experiments. The decrease in the intensity is slower than one would expect from the velocity of the electron, as deduced from the potential gradient, if there were an accelerating field in the tube; one would have to assume potentials greater than those applied to the terminals. Similar conclusions had been drawn by Holm [Abstracts 1384 (1916), 331 (1919), 1317 (1920)]. It is suggested that the primary electrons ionise and excite luminosity of the gas in the glow column, and that part of the secondary positive and negative ions diffuse in all directions and contribute by their recombination to the luminosity. Experiments with external electric and magnetic fields are finally described. H. B.

2294. *The Spectrum of Sodium at Low Voltages.* **F. H. Newman.** (Phil. Mag. 50. pp. 165–173, July, 1925.)—On the basis of Bohr's theory of atomic structure it is shown that the normal operation of an arc below ionisation should result in the excitation of a line-by-line spectrum corresponding to changes of orbit involving less energy than the ionising potential. Previous attempts to obtain such an emission with sodium vapour have failed. In the present work a three-electrode discharge tube was used, and the electrons emitted from a heated tungsten-wire kathode were accelerated by a potential difference applied between the grid and kathode. Photographic observations showed the development of the spectrum in the order of the potential predicted by theory. At 2·2 volts λ5896, 5890 only appear. At 4 volts the lines λ3303, 3302 are excited and the lines λ6161, 6154 and λ5688, 5683 are emitted at 4·4 and 4·6 volts respectively, in agreement with theory. W. V. M.

2295. *Luminous Vapour from the Mercury Arc and the Progressive Changes in its Spectrum.* **(Lord) Rayleigh.** (Roy. Soc., Proc. 108. pp. 262–279, June 2, 1925.)—This investigation deals with the luminous stream of vapour which is observed when mercury distils away from the arc *in vacuo*. (1) The spectrum lines of the arc forming known spectrum series are for the most part strongly developed in the vapour stream. An exception to this is the line 1850. (2) The arc lines not hitherto classified into series are faint or absent in the vapour stream. (3) The higher members of the various series appear in greater relative intensity in the distilled vapour than in the arc. (4) As the luminous stream passes on the character of its light changes. The higher members of the various series lose intensity relative to the earlier members, so that there is a relapse to and beyond the intensity distribution in the arc. (5) The continuous spectrum of mercury, not noticeable when the vapour first emerges, becomes more and more conspicuous as the vapour matures. (6) The continuous spectrum, whether produced in this way or directly by electric discharge, stops abruptly on the more refrangible side of 2537. (7) The behaviour of the luminous vapour is studied in an electric field. It is found that if the vapour is passed through a metal tube maintained at a negative potential the luminosity of the line spectrum in general tapers to a sharp point, beyond which it disappears entirely. The line 2537 behaves differently. (8) The bearing of these facts is discussed, but many of them appear very difficult to bring into line with received views as to the origin of spectra. W. V. M.

2296. *Excitation of the Spectra of Cadmium.* **A. E. Ruark** and **R. L. Chenault.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 653–659, June, 1925.)—The spectra were obtained from a three-electrode arc at applied potentials between 8 and 65 volts. The arc was formed in a Pyrex tube lived with a cylinder of very thin sheet iron. A tungsten kathode surrounded by a helix of nickel wire was supported at the centre of the cylinder. The central portion of the tube was heated by an electric furnace, and the discharge was drawn out by magnetic action of the heating current. The spectra were photographed with a Hilger quartz spectrograph. The results are given in a table of wave-lengths, voltage and intensity. Where possible the lines are classified into series. The forbidden lines found by Takamine and Fukuda in constricted arcs were not excited. F. S.

2297. *The Spectra of Doubly- and Trebly-ionised Phosphorus (P III and P IV).* **M. O. Saltmarsh.** (Roy. Soc., Proc. 108. pp. 332–343, June 2, 1925.)—The series system in the spectrum of doubly-ionised phosphorus has been determined to be a doublet system in accordance with the spectroscopic displacement law, and certain members of the principal, sharp and diffuse series have been identified and the corresponding series terms approximately obtained. Three members of the triplet-series of the spectrum of trebly-ionised phosphorus have been identified and certain of the series terms approximately determined. It has been observed that for three groups of elements, each having its own characteristic electron structure, the sharp terms are greater than the diffuse terms with the same Rydberg number for the neutral and singly-ionised element, but for higher stages of ionisation the diffuse terms are greater than the sharp. W. V. M.

2298. *Further Spectra associated with Carbon.* **R. C. Johnson.** (Roy. Soc., Proc. 108. pp. 343–355, June 2, 1925.)—A continuation of previous work [Abstract 1854 (1923)]. In the present paper observations and measurements have been described on the ultra-violet line-spectrum of carbon and comet-tail bands. The first negative band-spectrum of carbon has been remeasured and the lines disposed in series. Complete tables of results are given. It was found that the comet-tail bands could be represented by

$$\nu = K - 13\cdot 5\,(m + 0\cdot 35)^2$$

where K takes the values A_{1234}, B_{1234}, C_{1234}.

$A_1 = 64746$ $B_1 = 62563$ $C_1 = 60409$
$A_2 = 64760$ $B_2 = 62577$ $C_2 = 60423$
$A_3 = 64873$ $B_3 = 62690$ $C_3 = 60536$
$A_4 = 64887$ $B_4 = 62704$ $C_4 = 60550$

and m takes the values

A series	51–57
B series	53–57
C series	56–57

W. V. M.

2299. *On the Series Spectrum of Gold.* **J. C. McLennan** and **A. B. McLay.** (Roy. Soc., Proc. 108. pp. 571–582, Aug. 1, 1925.)—According to Bohr's scheme of electronic orbits for elementary atoms, the stable atoms of gold, silver and copper are supposed to have an outermost system consisting of one electron. This electron is represented as describing an elliptical orbit, in the case of gold of the 6_1 type, of silver of the 5_1 type and of copper of the 4_1 type. Following the analogy of the series spectra of the alkali elements, the arc spectra of gold, silver and copper should consist of doublet systems. Such systems are already identified in the case of silver and copper, but the present authors do not record any series for the arc spectrum of gold. Quartz and fluorite spectrographs of special design were used. The metal was vaporised in a small electrically heated carbon furnace, and photographs were taken of the spectrum of light from the arc or spark between terminals of the metal to be investigated after it passed through the metallic vapour. The distance from spark to slit was only 5 cm. The absorption spectrum of metallic vapours was thus obtained in the Schumann region, full experimental details being given. It was found that the second members of the principal series of doublets in the gold arc spectrum were $\lambda = 1646 \cdot 71$ and $\lambda = 1665 \cdot 75$. The term scheme for the arc series of gold has been shown to include two terms designated by $5\delta_1$ and $5\delta_2$ of the inverse δ type, and appear to correspond to metastable states of gold atoms. The term system includes two terms of the π_1, π_2 type, and one ϕ term—namely $9\phi_2$—was identified as 2817·2. The similarity between the term systems of Gold I, Copper I and Zinc II in respect to inverted δ terms is discussed fully. The ionisation potential of gold atoms is given as 9·25 volts. S. G. B.

2300. *Spectral Lines due to Two-Electron Jumps.* **R. A. Millikan** and **I. S. Bowen.** (Nat. Acad. Sci., Proc. 11. pp. 329–334, June, 1925.)—Recent work [see Abstract 1396 (1925)] has shown that the spectra of "stripped atoms" obey the Moseley and "irregular doublet" laws, so that a given type of spectral line progresses linearly with atomic number. It is now found that two-valence-electron systems are characterised by five nearly equalled spaced lines, of which the centre is about twice as intense as the others. Similarly three-valence-electron systems produce four lines together, the centre two being about one-half the spacing of each from its outer neighbour. Both types of group are shown to be due to simultaneous jumping of two electrons, and both show a linear progression with atomic number. F. S.

2301. *X-Ray Spectrography and Metallurgy.* **H. Weiss.** (Rev. de Mét. 22. pp. 333–354, June, and pp. 450–459, July, 1925.)—A review of the present state of the subject, containing a description of the apparatus and methods employed and the results obtained by different observers, with an account of some preliminary experiments made by the author on bronzes and alloys of gold and silver. In α-bronzes diffraction takes place as if the lattice of pure copper was dilated by the addition of tin, as is the case in the brasses and aluminium bronzes. The densities, however, do not agree with those calculated from the theory of addition or that of substitution; it is necessary to assume that an atom of Sn takes the place of several atoms of Cu. The difficulties are still greater in the case of other bronzes than the α-variety, and it is concluded that it is necessary to study isolated crystals to obtain satisfactory results. The second part of the review deals with the effects produced by mechanical deformations (cold working). It seems possible that the disagreement between the results obtained by Polányi and those of Wever with rolled aluminium is due to the fact that the latter carried the rolling farther than the former, so that a more perfect orientation of the crystals was obtained. H. N. A.

2302. *X-Rays in Industrial Control.* **H. Pilon.** (Soc. Franç. Elect., Bull. 5. pp. 121–136, Feb., 1925.)—This is a generally descriptive type of paper dealing with the following X-radiology subjects: Advantages of the Coolidge tube, the oil-immersed X-ray tube [see Abstract 1311 (1921)], applications of X-rays to detect metallurgical flaws, and to crystallography. It concludes with a description of a multiple plate ionisation intensimeter, of the type originally due to Duane, and of an ionoquantimeter due to Dauvillier. [See Abstract 862 (1924).] B. J. L.

2303. *The Theory of the Continuous X-Ray Spectrum.* **M. Bronstein.** (Zeits. f. Physik, 32. 11–12. pp. 881–885, 1925.)—It is shown that the quantum theory of light radiation, based upon the principles of energy conservation, requires the introduction of a small correction factor in the Einstein-Planck relation. This correction factor depends upon the angle between the X-radiation and kathode-ray paths. As a result the spectrum is slightly displaced towards the region of longer wave-lengths, and the Compton effect is so explained. The effect is, however, so small (less than 0·1 X units) that very precise methods would be necessary to confirm the theory derived in this paper from mathematical grounds. B. J. L.

2304. *Remarks upon the Quantum Theory of the Laue Effect.* **M. Bronstein.** (Zeits. f. Physik, 32. 11–12. pp. 886–893, 1925.)—Upon the Debye-Compton theory of X-radiation scattering, it is shown that the Duane quantum theory of the refraction of X-rays by crystal grids satisfies the variations from the Bragg reflection formula, as discovered by Hjalmar. The paper is nearly entirely mathematical, consisting of many pages of determinants, and is not suitable for abstraction. B. J. L.

RADIO-ACTIVITY.

2305. *The Phenomena of Atomic Disintegration by α-Rays.* **G. Kirsch.** (Phys. Zeits. 26. pp. 457–465, July 31, 1925.)—The author has found that in the case of nitrogen, when it is assumed that the first stage of a collision is the formation of an isotope of fluorine of atomic weight 18 (F^{18}), the differences between the internal energies of the F^{18} atoms produced by α-rays with 8·6, 7, 6 and 4·9 cm. range are 14, 9 and 12×10^{-7} ergs; the energies released in the emission of H-particles (protons) in these four cases are 93, 79, 71 and 59×10^{-7} ergs, the differences between these values being 14, 8 and 12×10^{-7} ergs, which are nearly the same as the previous energy differences. It seems probable that the life of the F^{18}, if it is really formed at all, is excessively short, and that an isotope of oxygen, O^{17}, is formed when the proton is ejected, which, judging by what happens in the case of the radio-active elements, may give out two α-particles in succession, forming the stable isotope Be^{9}. A study of the absorption curves of the H-rays from nitrogen shows that the observations agree with the theory, and apparently that all the H-particles originate from the N nuclei in the same way. With aluminium, on the other hand, there is evidence of two different groups of H-particles, one with much greater ranges than the other, and it is suggested that these originate in two different nuclear levels, the long-range group being produced from an inner, high-valued nuclear level by the most rapid α-particles and only when the collision is a central one. No space is available for the author's speculations as to the constitution of the nucleus or for other interesting results which have been obtained. H. N. A.

HEAT.

2306. *Dilatometric Anomaly of Solid Solutions of Copper and Aluminium.* **P. Chevenard.** (Comptes Rendus, 180. pp. 1927–1929, June 22, 1925.)—Between 250° and 300° C. the dilatometric curve of an aluminium bronze shows a distinct change of direction, while the curve resistivity-temperature and the thermal curve of Roberts-Austen also indicate a slight singularity. The author has studied the dilatometric curve by means of a differential dilatometer, made of a ferro-nickel chrome whose dilatation is free from singularity and perfectly reversible. The results are shown in diagrams, which exhibit a rapid increase of the coefficient of dilatation always in the neighbourhood of 265° C., and a maximum in the case of a bronze with 9·3 % aluminium. The anomaly is not affected very largely by the presence of the usual impurities of aluminium, except when this impurity is manganese; 1 % of manganese considerably reduces the effect. This anomalous increase in the value of the coefficient is nil for pure copper, increases to a maximum in the alloy containing 9·3 % of aluminium, and again disappears in the alloy containing 16 % of aluminium. T. B.

2307. *Temperature Scale and Melting-point of Molybdenum.* **A. G. Worthing.** (Phys. Rev. 25. pp. 846–857, June, 1925.)—In order to measure the spectral emissivities and temperature scales of Mo from 300° to 2900° K a tubular filament of pure Mo is made by winding ribbon in a close helix about 15 mm. long and 1 mm. in diameter. Spectral emissivities are then obtained by observing the ratio of the outer surface brightness to the interior brightness as seen through small holes in the wall. The results are checked by two other methods. At room-temperature the spectral reflectivities are determined and found to be independent of previous heat treatment. For 0·665 μ the emissivities at 300°, 1500° and 2800° K are 0·419, 0·371 and 0·331; for 0·475 μ, 0·424, 3·390 and 0·365 each within $\pm$ 0·007. These values are all lower than those reported by others, probably because of the greater purity of the Mo or of the better black body conditions. Hence these are believed more reliable. These emissivities lead to a difference between true temperature and brightness temperature as a function of the brightness temperature of 46° at 1000°, 113° at 1500°, 217° at 2000° and 370° at 2500° K. The melting-point of Mo is obtained by observing the brightness temperature of a Mo V-filament at melt and applying the correction to true temperature, and by two other methods. The rounded average of 97 readings yields 2895° K $\pm$ 10. This value is higher than most of the results of others. A. E. G.

2308. *Fundamental Data for the Use of the Optical Temperature Scale.* **F. Henning** and **W. Heuse.** (Zeits. f. Physik, 32. 11–12. pp. 799–822, 1925. From the Reichsanstalt.)—The paper discusses the relation between the intensity of monochromatic light of known wave-length and its absolute black body temperature. The treatise contains an exhaustive practical and theoretical treatment of the question and effects comparisons between values obtained by an optical coloured glass pyrometer and a spectropyrometer. The methods are employed to fix definite points in the scale, and the temperature of the melting-point of platinum is given as 1561° C., whilst the carbon arc temperature of the crater is fixed at 3430° C. The comparison of the methods up to 2300° C. is effected by a tungsten arc lamp, and incidentally the transparency and transmissibility of the colour screens employed and the effect of the ground-glass screens used are determined. The various corrections to be applied are given in detail and the formulæ used deduced step by step. S. G. B.

2309. *Mechanical Thermostats.* **J. R. Roebuck.** (Optical Soc. America, J. and Rev. Sci. Inst. 10. pp. 679–690, June, 1925.)—General considerations in connection with mechanical thermostats are discussed, but detailed applications are not described. The apparatus used are divided into three classes—*viz.* baths, heaters and coolers, responding devices—which may be combined in a variety of ways. A table of possible bath fluids, with their approximate effective temperature range, is given together with details of available stirrers and insulation. In connection with responding devices, bi-metallic strip, volume expansion types with the Gouy improvement (by which 0·001° constancy is readily obtained where the surroundings are steady and 0·0001° is quite possible), electrical resistance and thermocouple types are described. C. O. B.

2310. *Approximate Calculations of the Atomic Vibration Frequency of the Elements of the Zero Group* (*Inert Gases*). **J. Narbutt.** (Phys. Zeits. 26. pp. 470–471, July 31, 1925.)—Modifying Ratnowsky's formula of 1914 for the heat of fusion ρ per gm.-atom and using also the higher terms of the series [Abstract 1105 (1921)], the author finds that for the alkali metals Na, K, Rb, Cs the quotient α (ratio of the atomic frequencies of the solid and the liquid element) has the fairly constant value 4/3, and that the quotient ρ/T_s (melting-point at atmospheric pressure) is also nearly constant. But there can be no real constancy; otherwise $x = \Theta/T_s$ (where $\Theta = \beta\nu$, β being the constant $4 \cdot 77 \times 10^{-11}$ and ν the atomic frequency of the solid) should also be constant, whilst it ranged for the four metals mentioned from 0·429 down to 0·139. Both α and ρ/T_s probably undergo continuous changes in the periodic system. Referring to Simon [Abstract 3092 (1924)] and Eucken, the author calculates that the α for inert gases has the mean value 7/4, and that their atomic heats, in the solid and liquid states, range at their melting-points from 4·7 cal. (helium) to 6 cal. (Em.). H. B.

2311. *Potassium as a Mercury-Vapour Trap.* **A. L. Hughes** and **F. E. Poindexter.** (Phil. Mag. 50. pp. 423–439, Aug., 1925.)—The paper is a continuation of previous work by the same authors [Abstract 390 (1925)] on the use of distilled alkali metal trap for mercury-vapour in place of a liquid-air trap. Whilst the previous paper dealt with sodium, the present publication deals with potassium in detail. Using liquid air alone the residual pressure in the ionisation gauge after outgassing it by heat was $1 \cdot 4 \times 10^{-7}$ mm. On substitution of a potassium-lined trap for the liquid-air trap, and submitting to precisely the same heat treatment, the residual pressure was $0 \cdot 74 \times 10^{-7}$ mm. These values are not regarded as residual mercury-vapour pressures, but they indicate that gases are being slowly evolved owing to insufficient outgassing of the apparatus. The lowest residual pressure obtained with a potassium trap was 5×10^{-9} mm. This can be regarded as the upper limit to the vapour-pressure of mercury in a vacuum system beyond a potassium-lined trap. Several litres of moderately dry air passed over the potassium surface until it is dull black do not appreciably affect its trapping power for mercury. Using as criterion the first appearance of mercury lines in the helium spectrum at a pressure below 0·01 mm., it is noted that a potassium-lined trap acts as an effective barrier to mercury-vapour until the potassium has absorbed at least 150 % of its own weight of mercury. S. G. B.

2312. *An Improved Differential Method for the Exact Determination of Specific Heats of Aqueous Solutions, including Results for Various Salts and Organic Acids.* **T. W. Richards** and **F. T. Gucker, Jr.** (Am. Chem. Soc., J. 47. pp. 1876–1893, July, 1925.)—The authors develop a precise method of determining specific heats and obtain data for use in further chemical investigations. This involves the application of the adiabatic principle to Joule's twin-calorimeter method. Measurement of the very small temperature differences involved was made by thermoelements. One of the calorimeters was always used as a tare in the calorimetric balance; the other contained first water and then a solution, in alternate experiments. By this method of substitution many minor errors were avoided. Electrical resistance coils were developed, with adequate mechanical strength and small heat capacity, in which the heated wire was in good thermal contact with the solution, yet protected from its chemical action, and in which there was a minimum of thermal leakage to the outside. The results obtained with this apparatus are perhaps accurate to about 1 part in 10,000, the method is expeditious, and the necessary calculations very simple. The specific heats of three solutions were investigated at a mean temp. of 18° and of ten solutions at mean temps. of 16°, 18° and 20°. These results are recalculated in terms of absolute heat capacity and also reduced to instantaneous heat capacities at 14°, 16°, 18°, 20° and 22°. Most of the corresponding curves are similar to that for water, but the minimum values occur at lower temperatures. H. H. Ho.

2313. *The Boiling-points of Mixtures of Water, Benzene and Ethyl Alcohol under a Pressure of* 760 *mm. Mercury.* **J. Barbaudy.** (Comptes Rendus, 180. pp. 1924–1926, June 22, 1925.)—The great practical value attached to the distillation of this ternary system, enabling the dehydration of alcohol, has induced the author to undertake the present complete study of the nature of the equilibrium. There exists a concentration domain in which mixtures of alcohol-water-benzene are heterogeneous at the boiling-point. By means of a small ebullioscope of 20 c.c. capacity the boiling-points of several series of known mixtures have been determined in the homogeneous region, but for the heterogeneous region a large ebullioscope of 250 c.c. capacity, furnished with stirrer, was employed. A very complete ternary diagram is included and discussed. Young's minimum boiling-point of 64·85° C. is confirmed.
H. H. Ho.

2314. *Effect of a Non-volatile Solute on the Partial Pressures of Liquid Mixtures at the Boiling-point.* **B. H. Carroll, G. K. Rollefson** and **J. H. Mathews.** (Am. Chem. Soc., J. 47. pp. 1785–1791, July, 1925.)—The change in partial pressures produced by addition of a non-volatile solute to binary liquid mixtures at the boiling-point was measured for eight systems at several compositions. The method employed was that described in a previous paper [see Abstract 1473 (1909)], and consisted in distillation under conditions such as to avoid reflux condensation, collecting successive measured samples of distillate, analysing plotting composition against percentage distilled, and extrapolating to zero distillate. The selective action of a non-volatile solute on the partial pressures of a liquid mixture has been found to be measurable in systems, which, as a whole, obey the laws of dilute solution; it is roughly correlated with relative solubility in the separate solvents. F. J. B.

2315. *Ebullioscopic Measurements in Mixed Solvents.* **B. H. Carroll, G. K. Rollefson** and **J. H. Mathews.** (Am. Chem. Soc., J. 47. pp. 1791–1799, July, 1925.)—Rise of boiling-point caused by the addition of camphor, thymol, benzoic acid, acetamide, succinic acid and mixed solvents was observed. The apparatus used was capable of high accuracy, 1 %, and had an automatic pressure regulator capable of being used for other chemical and physical purposes. It was found that the Lewis equation for change in boiling-point of a binary mixture on the addition of a non-volatile solute was fulfilled with the same degree of accuracy as the other laws of dilute solutions. F. J. B.

2316. *Freezing-points of Hydrofluoric Acid.* **J. D. C. Anthony** and **L. J. Hudleston.** (Chem. Soc., J. 127. pp. 1122–1128, May, 1925.)—Using wax vessels, the freezing-points of 0·025 — 4M-solutions of hydrofluoric acid are determined and the activities calculated. The postulate that hydrofluoric acid gives rise to complex ions, HF_2, in addition to simple ions receives confirmation, and the composition of the acid worked out on that assumption (together with that of the validity of the law of mass action applied to the concentrations) is supported. No appreciable amount of double molecules, H_2F_2, appears to exist. G. A. S.

2317. *The Influence of Ray Density and Geometrical Dimensions upon the Formation of Deposits from Molecular Rays.* **J. Estermann.** (Zeits. f. Physik, 33. 4. pp. 320–324, 1925.)—The dependence of the critical condensation temperature of metallic vapours upon the concentration of the molecules in the ray incident upon the plate upon which deposition occurs has been investigated in the case of molecular rays of cadmium striking plates of either glass, silver, or copper, and of rays of mercury incident upon silver. Values are deduced for the respective vapour-pressures and heats of adsorption of the deposits produced. The shape of the deposit is determined by the fact that the critical condensation temperature is lower at the marginal zone than at the centre of the deposit. J. S. G. T.

2318. *Determination of the Heat of Dissociation of Hg Molecules from the Band-Spectrum of Hg Vapour.* **E. Koernicke.** (Zeits. f. Physik, 33. 3. pp. 219–230, 1925.)—For the measurements a glow-lamp with a small tantalum ribbon as filament was used, the lamp having a quartz window. The light proceeds through a cylindrical tube having another quartz tube at its centre. This vessel is evacuated and mercury is then admitted. The tube is placed partly in an electrical stove where temperatures up to 1000° C. are employed, the temperatures being measured by a Pt-resistance thermometer, and partly in a second stove kept between 200° and 250° C., the temperature being measured here by a copper-constantan thermocouple. Equations are established for the dissociation under different conditions. The Hg band at 2540 Å. is recognised at not too high pressures as a real molecular band and ascribed to Hg_2. From the intensity of this Hg_2 absorption band at different temperatures and pressures the heat of dissociation is determined as 1·4 kilocalories, and thus the intensity of absorption of the light serves as a relative measure of the number of molecules. R. S. R.

2319. *Heats of Solution and Dilution of Salts, Extreme Dilution to Saturation. Part I. KCl, KBr, KI, NaCl, NaBr, NaI.* **J. Wüst** and **E. Lange.** (Zeits. phys. Chem. 116. pp. 161–214, June 15, 1925.)—Further particulars of Abstract 599 (1925). The salts are either added gradually to definite volumes of water, or varying quantities are dissolved, or concentrated solutions are diluted; only the last method is applicable to the saturation range. In the other cases an adiabatic calorimeter is used, and the heat capacity is determined electrically. The methods and apparatus are discussed. The whole range of concentration being investigated, it is possible also to determine by extrapolation the final heat of solution, thermodynamically connected with the temperature coefficient of solubility. For equal concentrations the curve values of the differential heats of solution are the more negative the larger the ions of the salt in question. Only the Na salts show a systematic gradation in these heat values; the potassium salts seem irregular, but the relations become clearer when the heats of hydration of the ions and of expansion are distinguished. H. B.

2320. *Heats of Solution and Heats of Incomplete Reaction.* **(Miss) Bérenger** and **A. Tian.** (Comptes Rendus, 180. pp. 1907–1910, June 22, 1925.)—When a chemical reaction takes place normally in solution heat quantities may be defined as follows: $Q =$ the heat of reaction in a given solvent S; $Q_1 =$ the heat of solution in S of all the reactants; $Q_2 =$ heat of solution in S of all the resultants. A new heat of reaction X may now be defined by the equation $X = Q + Q_1 - Q_2$, which may be regarded as the heat of reaction of the undissolved reactants, a quantity independent of the nature of the solvent. The value of X may be readily derived where it is possible to measure Q, Q_1 and Q_2. The values of Q_1 and Q_2 can be measured without difficulty in the case of a reaction which has gone to completion, and likewise in a case of an uncompleted one which occurs in dilute solution, for in this case Q_1 (or Q_2) is the sum of the heats of solution in S of the reactants (or resultants) considered separately. In the more usual case, where in order to obtain measurable heat quantities the reaction must be carried out in concentrated solution, the measurement is more difficult. Theoretically the above equation still holds, but the pure solvent S must be replaced by a solvent S′ identical with the solution itself at the moment considered. As the nature of S′ is continually changing, measurements of Q_1 and Q_2 are in general impossible, but two particular cases lend themselves to approximate treatment: (1) When the reaction occurs with measurable velocity only in the presence of a small amount of a catalyst. In this case the heats of solution for each substance in S′ can be measured in the absence of the catalyst, it being assumed that the thermal effect is unaltered. (2) Where by the help of a suitable catalyst the rate of reaction can be made much slower than the rate of solution of the reactants. Using an integrating calorimeter, the heat effect Q is observed over a long period. Apparent values of Q_1 and Q_2 are next observed as in (1), but subject to a small correction due to the slow chemical change. T. B.

2321. *On the Statistical Consideration of the Temperature Dependence Parameter and the Debye Theory of Electrolytes.* **P. Gross** and **O. Halpern.** (Phys. Zeits. 26. pp. 403–407, June 30, 1925.)—In statistics the parametric dependence of the potential energy of a system A signifies dependence on the coordinates of another system B, which does not come under statistical consideration. In the majority of problems these parameters are independent of temperature, but the present paper deals mathematically (thermodynamically) with the case of temperature dependence. Application is made to an ionic solution whose potential energy is a function of the temperature-dependent dielectric constant of the solvent. The work of Milner, Cavanagh and Debye is discussed. Lack of concordance between theory and measurement is critically examined. H. H. Ho.

2322. *Thermal Separation in Gaseous Mixtures.* **G. A. Elliott** and **I. Masson.** (Roy. Soc., Proc. 108. pp. 378–385, June 2, 1925.)—It has been shown by Chapman, Dootson and Ibbs [see Abstract 1999 (1921)] that the composition of a gaseous mixture varies when the temperature is made to vary from point to point within it, the extent of separability depending upon the character of the intermolecular fields of force and the relative molecular weights, sizes and concentrations.

The present authors have studied the behaviour of mixtures of hydrogen, helium and carbon-dioxide, maintaining a constant temperature difference of about 500° C. between two intercommunicating bulbs until a steady state was reached, and then analysing the contents of each bulb. They find that (1) the constituent of higher molecular weight becomes more concentrated in the colder part of the mixture; (2) the greatest differences exceeded 10 % in mixtures of H_2 and CO_2, 12 % in He and CO_2, and approached 4 % in H_2 and He; (3) for each pair of gases there is, as theory predicts, an optimum mixture. This occurs with about 55 % of H_2 in $H_2 - CO_2$, 60 % of He in $He - CO_2$, and 60 to 55 % of H_2 in $H_2 - He$. The results are fairly represented by Chapman's former equations for rigid elastic spheres if the theoretical value of k_T in the equation $\lambda_c - \lambda_h = k_T \log_e (T_h/T_c)$ is multiplied by 0·70 for $H_2 - CO_2$, 0·78 for $He - CO_2$, and 0·72 for $H_2 - He$. In the equation quoted λ_h and λ_c are the molar fractions of the heavier constituent, and T_h and T_c are absolute temperatures of the hot and cold regions. T. B.

2323. *The Effect of Radiation on Gaseous Mixtures.* **H. Senftleben.** (Zeits. f. Physik, 32. 11–12. pp. 922–932, 1925.)—The exposure of a mixture of a polyatomic gas and a vapour to radiation corresponding to the resonance line of the vapour produces a definite effect which is relatively simple to measure. The effect arises as a variation of the conductivity for heat of the gas, and has its origin in the two methods of dissociation of the polyatomic gas which result from the impacts produced. By means of this effect an estimation of the heat of dissociation of polyatomic gases is afforded, and this is utilised further to give information regarding the primary conditions of disturbance and excitement of the gases. Experimental details and tables of results are fully given. S. G. B.

2324. *The Third Law of Thermodynamics and Calculation of Entropies.* **T. J. Webb.** (J. Phys. Chem. 29. pp. 816–833, July, 1925.)—The free energy (F) change accompanying a reaction is given by the equation $-\Delta F = T\int\frac{\Delta H \,.\, \partial T}{T^2} + I \,.\, T$, where I is a constant of integration.

$$\text{Also} \quad \Delta H = \Delta H_0 + \Delta\Gamma_0 \,.\, T + \tfrac{1}{2}\Delta\Gamma_1 \,.\, T^2 + \tfrac{1}{3}\Delta\Gamma_2 \,.\, T^3 + \ldots$$

where ΔH_0 is the heat of reaction at absolute zero and $\Delta\Gamma'_s$ stand for the increments of the heat capacity terms. Nernst's formulation of the third law is $I = 0$ and $\Delta\Gamma_0 = 0$. Verification of this law requires an accurate knowledge of specific heats over the whole temperature range. Entropy (S) relations may furnish a further test. It may be deduced that at absolute zero $-\Delta S$ and ΔC_p approach zero; also that the entropy of a compound is the sum of the entropies of its constituent elements. This necessitates that all elements and compounds have zero entropy at the absolute zero. In the paper the law is subjected to test by the application of entropy relations for cadmium chloride and iodine. In this the author considers the data on free energy changes reliable, but not the total energy changes which are deduced from the temperature variation of free energy changes. Total energy change should be determined calorimetrically and not deduced from the temperature coefficient of reversible galvanic elements. The heat of formation of silver iodide is redetermined as 14,975 cals. (max. error 50 cals.). The entropy of iodine is then calculated (1) from the energetics of the silver iodide combination as 13·95, (2) from the energetics of the zinc iodide combination as 14·05, and (3) from the specific heat of iodine as 14·24 units at 298° abs. [Recent specific heat data for iodine in a paper by Lange give $S_{298} = 13{\cdot}95$.] The heat of formation of silver bromide is determined and the entropy deduced as 25·68 units. If a specific heat curve over the entire range were available the entropy could be determined independently and the value of the bromine potential deduced. L. L.

2325. *On the Extension of Phenomenonological Thermodynamics to Oscillation Phenomena.* **L. Szilard.** (Zeits. f. Physik, 32. 10. pp. 753–788, 1925.)—In this mathematical paper it is shown by means of purely phenomenonological thermodynamical considerations applied to systems in thermodynamic equilibrium, but containing parts whose energy undergoes periodic variation, that the average values of these variable parameters not only conform to the second law, but also that the latter affords information on the regularities of the deviations from these average values. H. H. Ho.

SOUND.

2326. *Zones of Silence.* **E. Esclangon.** (Comptes Rendus, 180. pp. 1412–1415, May 11, 1925.)—Discusses the conditions of reflection and refraction of sound waves at the bounding surface of two layers of air in relative motion and their effects in producing zones of silence. G. A. S.

2327. *Sound Waves in the Earth.* **Barré** and **Schnell.** (Comptes Rendus, 180. pp. 1415–1416, May 11, 1925.)—Using the explosion of May 26, 1924, it was found that the sound wave transmitted by the earth could be heard distinctly between distances of 2800 and 3030 metres, but less so at shorter distances. The velocities of propagation through the earth were divided into two groups, 2000 ± 600 metres/sec. and 8500 ± 700 metres/sec., according as source and observer were on sand or rock. G. A. S.

2328. *Vibrations of a Cylindrical Air Column.* **C. Barus.** (Nat. Acad. Sci., Proc. 11. pp. 260–264, May, 1925.)—The nodal pressures at the centre of a tube whose ends are closed by telephone plates are measured by pinhole probes for different pitches and different relative phases of the end plates. Curves show the results obtained. G. A. S.

2329. *Reverberation Equations for Two Adjacent Rooms connected by an Incompletely Sound-proof Partition.* **A. H. Davis.** (Phil. Mag. 50. pp. 75–80, July, 1925.)—Equations are derived for the decay in the intensity of sound in each of two chambers connected by an incompletely sound-proof partition when a source in one of the chambers is suddenly stopped. The general relations are complicated, but become simple if the receiving chamber has adequate absorbing power compared with the transmitting power of the partition and with the absorbing power of the source room. G. A. S.

2330. *Cylindrical Pipe with Lateral Hole.* **E. Ratz.** (Ann. d. Physik, 77. 2. pp. 195–215, July, 1925.)—An electrical method is used to investigate the wave-length and the distribution of pressure in the vibrating air column inside a cylindrical pipe. The method is then used to study the influence of a hole bored in the side of the pipe. The hole causes (1) two new nodes, one on each side of the hole; (2) displacement of the nodes and anti-nodes; and (3) a change of amplitude. The influence of the position and diameter of the hole upon these three factors is studied. With the help of this work and the Steinhausen theory it is possible to determine with sufficient accuracy the pitch and density changes for a pipe having a lateral hole of *any* diameter and position. The results are summarised in ten graphs. W. H. Ge.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2331. *The Bursting of Soap-bubbles in a Uniform Electric Field.* **C. T. R. Wilson** and **G. I. Taylor.** (Cambridge Phil. Scc., Proc. 22. pp. 728–730, July, 1925.)—Two circular metal plates were mounted horizontal and parallel; the lower one was wetted with soap solution and a measured soap-bubble was placed upon it, where it took a hemispherical shape. An adjustable difference of potential was established between the plates by means of an influence machine and a battery of Leyden jars in parallel. The bubble elongated as the field increased, becoming like the small end of an egg, and rapidly getting narrower at the end and then pointed as the field grew larger. At this stage the end vibrated with great rapidity, and photographs taken by means of a spark showed that filaments or drops were then thrown off from the end; one of the photographs shows an almost perfect cone. It is shown that the field which causes the bubble to become just unstable should, theoretically, be inversely proportional to the square root of the radius of the undistorted bubble, and this is confirmed by a series of measurements on bubbles with radii ranging from 0·251 to 1·062 cm. The authors conclude that the largest water drop that can exist in a field of 30,000 volts per cm., which is the greatest field without sparking in air at atmospheric pressure, has a radius of 0·02 cm. H. N. A.

2332. *Atmospheric Conductivity and Electric Currents.* **C. Maurain, E. Salles** and **G. Gibault.** (Comptes Rendus, 180. pp. 1955–1957, June 22, 1925.)—Following on a previous paper [see Abstract 3027 (1924)], the results of two years' observations are given. Measurements of conductivity, continuously recorded since the beginning of 1924, are also tabulated. Contrary to what is found with the electric field, conductivity is greater in summer than in winter. Speaking generally, these two elements tend to vary inversely, but a prolonged period of observations is necessary before the yearly variation of conductivity can be fixed. Visibility was determined simultaneously with each measurement of conductivity, the results pointing to the conclusion that the greater the conductivity the better is the visibility. E. F.

DISCHARGE AND OSCILLATIONS.

2333. *Electric Discharge in Gas at Low Pressures.* **R. Magini.** (N. Cimento, 2. pp. 83–124, April–May–June, 1925.)—In this preliminary paper the following are among the points considered: The experimental arrangement and method of observation; visibility of the kathodic and canal bundles at various pressures—photography of the discharge; material of the kathode; degenerate discharge; uniformity of the positive afflux; bundles from apertures; nature of the canal bundles; origin of bundles from gaseous kathodes; emission from slits; origin of canal rays; peri-kathodic and post-kathodic shadows and motion of the positive ions. A. E. G.

2334. *A Generalisation of the Townsend Theory of Spark Potentials.* **W. Dällenbach.** (Phys. Zeits. 26. pp. 407–410, June 30, 1925.)—This paper is of a mathematical nature and, as indicated by its title, deals with a generalisation of the Townsend theory, which is only applicable for certain values of the product *ps*. A. E. G.

2335. *Present Position of Theory of Glow Current.* **R. Holm.** (Phys. Zeits. 26. pp. 412–420, June 30, 1925.)—This is a supplement to the previous paper on this subject by the author [see Abstract 639 (1925)], and the following are among the points considered: Mobility and form of ions; setting free electrons from metals by means of canal-ray collisions; the similarity law; the Townsend discharge form; the pseudo-high vacuum; the kathode fall; the current density at the kathode; determination of the position of the edge of the glow; theory of the part taken by kathode in the discharge; the anode fall; Schottky's theory of the positive column; the positive layers; the electric spark; corona. A useful list of the literature on the subject is appended. A. E. G.

2336. *The Theory of the "Schrott-effect."* **N. R. Campbell.** (Phil. Mag. 50. pp. 81–86, July, and p. 808, Oct., 1925.)—A theoretical paper in which attention is drawn to a general proposition relating the fluctuations in any fortuitous phenomenon and those in an instrument by which it is observed. Use of it would avoid the elaborate calculations upon which the study of the Schrott-effect has been based hitherto, and enable the observations to be interpreted much more directly in terms of measurements. The results obtained by Hull and Williams with secondary emission are discussed; it is shown that conclusions other than those that they draw are not excluded. [See Abstract 541 (1923).] A. E. G.

2337. *Red Limit and Emission Energy of Photoelectrons.* **R. Suhrmann.** (Zeits. f. Physik, 33. 1–2. pp. 63–84, 1925.)—The photoelectric sensitivity curves of platinum, gold and silver with varying gas load were established by means of highly sensitive instruments, and from them, applying the theory of glow electrons to the photoelectric effect, "photoelectric straight lines" were calculated whose constants M and n accurately characterised the photoelectric behaviour of a metal, even with varying gas load. The constant n allows of the calculation of the emission energy or of the red limit ν_0 at absolute zero. With the aid of the "photoelectric straight lines" it is possible to fix a temperature scale on the basis of the radiation and to utilise photocells as total radiation pyrometers. An illustration of the apparatus is given and the results are set forth in numerous tables and curves, for which the original paper, which is largely mathematical, should be consulted. E. F.

2338. *The Passage of Electrons through Small Apertures.* **J. F. Lehmann** and **T. H. Osgood.** (Cambridge Phil. Soc., Proc. 22. pp. 731–737, July, 1925.)—The velocities of electrons emerging through an aperture in an anode to which they are accelerated are measured by directing them into a Faraday cylinder to which varying retarding fields are applied. Curves are plotted giving the value of the electronic current with different accelerating and retarding potentials, both of which ranged up to 1000 volts. The anode apertures are arranged in thin copper sheet from 0·13 mm. to 3·24 mm. in diameter, or consist of capillary tubes 0·40 to 1·25 mm. in diameter and 5 to 16 mm. long. It is found that with the largest apertures employed and the highest accelerating potentials the fraction of the electrons, which pass through with a velocity equivalent to the accelerating field, in no case exceeded 80%. In the case of the largest apertures, the magnitude of the accelerating potential between 200 and 1000 volts does not appreciably affect the fraction of full-velocity electrons. The results indicate that the electrons during their passage through the aperture strike the walls and produce secondary electrons of comparatively low velocity. J. N. P.

2339. *The Photoelectric Effect in Potassium Vapour as a Function of the Frequency of the Light.* **E. O. Lawrence.** (Phil. Mag. 50. pp. 345–359, Aug., 1925.)—Experimental data on the photoelectric effect in vapours which have a direct significance in the Bohr theory are somewhat scanty and comprised in the work of Steubing, Anderson and Gilbreath, Kunz and Williams [see Abstract 595 (1924)], and Williamson. The latter has indicated that the threshold for potassium vapour lies between 2800 Å. and 3100 Å., and has also shown that the efficiency of the light in producing the effect increases rapidly with the frequency. The present paper is an account of an experimental investigation of a more quantitative nature of the photoelectric effect in potassium vapour, the method used being similar to that of Williamson [Phys. Rev. 21. p. 107, 1923], full details being given. It has been found that light of wave-length greater than 2610 Å. produces no effect, and that the efficiency of the light in producing ionisation increases as shorter wave-lengths are used. Because of the inconsistency with the Bohr theoretical interpretation of spectroscopic data on atomic potassium, the photoelectric effects observed are regarded as most probably due to a molecular state of the vapour. H. H. Ho.

2340. *Experimental Study of the Direction of Emission of Photoelectrons.* **P. Auger.** (Comptes Rendus, 180. pp. 1939–1941, June 22, 1925.)—In a previous publication the author and F. Perrin have deduced the formula $P = \sin^3 \omega d\omega \, . \, \sin^2 \lambda d\lambda$ for the relation between P, the probability that β-rays or photoelectrons are thrown out in a small solid angle $d\omega d\lambda$, making the angle ω (co-latitude) with the direction of propagation of an exciting beam of X-rays, λ being the azimuth about this beam, reckoned from the plane perpendicular to the electric vector. The distribution can be determined either by the Wilson cloud method or by means of the Geiger counter. In the present paper curves are drawn showing the manner in which the emissions should be distributed for different values of ω according to the above equation, together with the experimental results, using 90 kilovolts and 15 kilovolts to produce the X-ray beam. All three curves are of similar form, but the experimental angles are somewhat smaller than the theoretical for 15 kilovolts and still smaller for 90 kilovolts. The amounts of these shifts agree with the results of the previous paper. Curves are also given for the distribution in azimuth, using the values obtained by Bubb, and these show good agreement with the theory. A curve showing the distribution of the tertiary β-rays proves that, in the case of krypton, the excited atom radiates the energy into space according to the laws of probability.

H. N. A.

2341. *Statistical Theory of Emission of Electrons from Hot Bodies.* **S. C. Roy.** (Phil. Mag. 50. pp. 250–263, July, 1925.)—In this paper the law of thermionic emission, in the form $I = \{2\pi mek^2/h^3 K_2(T)\}\{T^2 . \epsilon^{-\chi/kT}\}$, is presented as a theorem in statistical mechanics. The function $K_2(T)$, which depends on the frequencies of metallic electrons, appears from evidences of excess specific heat of metals over Dulong-Petit's value 3R not to differ much from unity up to the melting-point of metals. It is next shown, on the basis of the theory of complete reversibility of physical processes, that the emission law is the same if the mechanism be supposed to be radiative. The assumptions adopted in deducing this law are: (1) The electrons inside the metals form space-lattices like the atoms in a crystal, and share in heat energy according to Planck's law of quanta; (2) the external electrons are regarded as constituting an ideal monatomic gas, and are supposed to be emitted with Maxwell's law of distribution of velocities. A note is added to the effect that recent work of J. J. Weigle gives further support to the idea of electron space-lattices in metal crystals. [See also Abstract 409 (1925).]

A. E. G.

2342. *The Action of the Electrical Counter.* **K. G. Emeléus.** (Cambridge Phil. Soc., Proc. 22. pp. 676–683, July, 1925.)—It is assumed that the current in the counter is one of molecular ions (positive) and electrons, and that the positive ions only produce secondary ions when they impinge on an electrode. Electrons move inwards towards a positive electrode, and at a certain distance from it, where the field is strong, they attain a velocity sufficient to produce fresh ionisation by collision, the resulting + ions moving outwards slowly without ionising the gas. When the primary ionising agent is removed the electrons are all rapidly attracted to the point, ionisation ceases, and the current stops. When the point is negative it must be very fine. The main fall of potential is very near the point, and any large magnification of the ionisation must arise from ionisation due to positive ions attracted to the point; it is probable that most of this takes place by collision with the solid surface, giving electronic δ-radiation. These electrons, and the secondary electrons produced by them, cause further ionisation, and pass outwards, leaving a positive space-charge round the point. The result will be an electrical wind towards the point with an increase of pressure; the + ions will be spread over the tip of the point by this wind, and if there is a strong lateral field they will liberate electrons from an increased area, giving a bigger discharge. The increase in gas-pressure near the point diminishes the mean free path of the + ions, their velocity does not rise enough to produce the δ-radiation, and the discharge ceases.

H. N. A.

2343. *Thermionic Emission.* **N. v. Raschevsky.** (Zeits. f. Physik, 32. 10. pp. 746–752, 1925.)—Assuming the electrons emitted from a hot solid obey the laws of a perfect gas, and regarding the phenomenon as an evaporation process, the thermionic current is given by the well-known expression $i = Ae^{-b/T} . T^a$. The author discusses briefly the methods adopted by O. W. Richardson, S. Dushman and S. Roy for deriving this expression and the value to be assigned to a according to the assumptions made with regard to the electrons in the interior of the solid. He then treats the problem from the kinetic standpoint, starting with distribution formula given by R. H. Fowler [Abstract 1484 (1923)]. The results arrived at agree with those of the earlier investigators, *viz.* (1) if the energy of the internal electrons is independent of temperature, $a = 2$; (2) if free electrons are assumed in the interior, $a = \frac{1}{2}$. It is also shown that if an electronic lattice be assumed then $a = -1$. L. L.

2344. *Distribution of Initial Velocities among Thermionic Electrons.* **L. H. Germer.** (Phys. Rev. 25. pp. 795–807, June, 1925.)—The experimental arrangements are fully described, and the results obtained are shown in both tabular and graphical form. It is concluded that these experiments prove that the thermionic electrons emitted from tungsten into a high vacuum have velocity components distributed according to Maxwell's law for the distribution of velocities in an electron atmosphere in temperature equilibrium with the hot filament. A. E. G.

2345. *The Mechanism of Photoelectric Action.* **S. Ray.** (Zeits. f. Physik, 33. 3. pp. 231–236, 1925.)—The author has previously shown that in the Maxwell electromagnetic wave the ratio a/λ between the amplitude and the wave-length must be constant for every oscillation number. From this result it is now derived on the basis of the energy principle that, in the case of the light energy absorbed by a screen, it is only converted into electric work, namely into work which sets free the ions adsorbed by the walls of the bodies, the Einstein equation $Ve = h\nu$, according to classical electrodynamic, is valid. A. E. G.

2346. *Propagation and Distortion of an Electromagnetic Perturbation.* **A. Dufour.** (J. de Physique et le Radium, 6. pp. 139–143, July, 1925.)—It is well known that when an electromagnetic perturbation is propagated along an insulated conducting line of not negligible resistance it undergoes an alteration of form, or distortion. In order to establish directly the existence and the nature of this distortion, by registering the form itself of the variation of tension of the perturbation considered, use is made of the kathodic oscillograph, which has been previously described by the author. The method of observation and the experimental arrangement is fully described. The observations are limited to lines of small length consisting of wires of copper or iron. The distortion is found to be very slight when the line is of copper; it is, however, considerable for an iron line. Photographs of some of the results obtained are given. A. E. G.

2347. *The Oscillations produced by Means of a Tungar Rectifier.* **Y. Watanabe.** (Tôhoku Univ. Technol. Reports, 5. 1. pp. 1–9, 1925. In English.)—In the paper by the author [see Abstract 368 B (1923)], "On the Characteristics of the Arc of Tungar Rectifier," it was stated that an oscillating current flows through the condenser across the terminals of the arc, and that the frequency depends upon the arc voltage. In the present paper it is intended to state the relation between the oscillations produced in the arc and the heating condition of the filament with some oscillographic records of the oscillating currents. The arrangement of the circuit is shown diagrammatically. The oscillations in the direct current arc are first investigated. When the condition of the circuit is kept unchanged and the filament current is increased, the arc voltage decreases, with the result that the frequency of the oscillating current, produced in the arc, also decreases. When the filament current is comparatively small, being less than several amperes, the oscillating current is of relatively high audio-frequency and of low effective value of about 0·1 amp. This oscillation may be considered to be due to an ionic oscillation of negative ions in the arc. When the filament current is increased further up to about 10 amps., the oscillation stops entirely, and when, however, more than 14 amps., an intermittent current is suddenly produced, which is of relatively low audio-frequency at several hundred cycles per sec. and of effective value as high as 1 amp. The intermittent current is next investigated, and an attempt is made to explain the manner in which an intermittent current is produced by the dynamic characteristic curve of the arc of Tungar for the condition at which the oscillation takes place with an intensely heated filament. It is, however, impossible to obtain directly the dynamic characteristic curves by the usual method, by means of a Braun tube, on account of the low arc voltage. It can be derived indirectly from the wave-form of the oscillating current in the manner here shown. A. E. G.

2348. *Harmonics of Valve Oscillators and Extremely Short Waves.* **C. Gutton** and **E. Pierret.** (Comptes Rendus, 180. pp. 1910–1912, June 22, 1925.)—For the production of very short waves the dimensions of valve oscillators become increasingly small, so that the shortest wave produced by this means was 1·20 metres, obtained by Mesny [see Abstract 1905 (1924)]. Shorter waves have been obtained by other means, but the power involved has been very small. An attempt has been made to isolate and measure the harmonics from high-frequency oscillators with a view to their subsequent amplification. The harmonics are detected by means of a resonating circuit which consists of two parallel wires joined at one end by an iron-constantan thermoelectric couple connected to a Rubens armoured galvanometer, the circuit being completed by means of a sliding copper bridge. The positions of the bridge when resonance occurs are indicated on the galvanometer, and can be determined to 1 mm. The position of the bridge corresponding to the fundamental wave is first determined by means of loose coupling. The coupling is then tightened and a search is made for the harmonics. The radiation from various types of oscillator has been analysed and the nature and intensity of the harmonics are described. By means of a special form of oscillator, consisting of two valves in series using capacity coupling, oscillations were obtained whose fundamental wave-length was 136 cm. The third harmonic was particularly strong, with a wave-length of 45·4 cm. Its effective intensity was of the order of a tenth of an ampere. A similar oscillator of fundamental wave-length of 176 cm. gave a fifth harmonic corresponding to 35 cm. Harmonics of higher orders were observed, but owing to crowding precise measurements could not be carried out. T. B.

2349. *Theory of the Magneton, taking into Account the Variation of the Mass of the Electron with Velocity.* **L. Page.** (Phys. Rev. 25. pp. 841–845, June, 1925.)—In a previous paper the exact expression for the critical voltage necessary to drag electrons to the cylindrical anode when an axial magnetic field is acting parallel to the central filament was derived, taking into account the variation of mass with velocity. The exact theory is now extended to cover the case when the filament current is so large that its concentric magnetic field is not negligible. The exact theory begins to differ from the approximate theory, in which the mass is treated as constant, by an appreciable amount (2 %) for a critical potential of 20,000 volts, the divergence increasing approximately in proportion to the voltage. Since 20,000 volts corresponds to an axial field of the order of 200 gauss or a filament current of the order of 700 amps., it should be possible to verify by experiment this exact theory, and with it the relativity expression for the longitudinal mass of the electron, which is involved. [See Abstract 2138 (1925).]

A. E. G.

2350. *Electric and Magnetic Spectroscopy.* **W. Arkadiew.** (Phil. Mag. 50. pp. 157–163, July, 1925.)—In the central part of the spectrum of electromagnetic waves, where the frequency of the wave is equal (or nearly so) to the natural frequencies of the electric centres, we have a region of vast variations of refractive index and dielectric coefficient—the region of electric dispersion. The thermal waves have the same relation to the magnetic centres as the X-rays to electric centres. Between these thermal oscillations and slow electric vibrations must be the disappearance of the magnetic behaviour, accompanied by magnetic absorption of the passing rays and strong alterations of magnetic permeability. This region occurs for wave-lengths of 1 cm. up to 1 km. Knowing the intensity of magnetisation and the density, it is possible to calculate the radius a of the elementary magnets. The values obtained range from $0{\cdot}87$ to $1{\cdot}49 \times 10^{-8}$ cm. for iron and $1{\cdot}12$ to $1{\cdot}28 \times 10^{-8}$ for nickel. The paper is well illustrated with curves showing the variation of coefficient of absorption of the waves in iron and nickel with wavelength, as well as electric dispersion and absorption and magnetic dispersion and absorption. W. V. M.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2351. *Conduction of Electricity in Alloys containing Mixed Crystals.* **G. Borelius.** (Ann. d. Physik, 77. 2. pp. 109–137, July, 1925.)—The theory of Højendahl [see Abstract 2835 (1924)] connecting electrical conduction with the mean free path of the conducting electrons is developed with special regard to mixed crystals in alloys. At the absolute zero the specific conductivity H_0 is expressed by $H_0 = A\frac{p}{q} + ap + B\frac{q}{p} + bq$, where p and q are concentrations of the components A, a, B, b are constants depending on the number of electrons, mean free path and distance apart of the atoms. Further, the conductivity at absolute zero may be calculated from measurements at higher temperatures by extrapolation. Conductivity measurements for alloys of AuAg, AuCu, PdPt, PbIn, KRb, treated in this way, yield smooth curves when conductivity is plotted against concentration, which are in accordance with formula above. The existence of compounds, as with AuPd, AgPd, etc., is shown by a peak on the curve. The values of A should be constant in mixtures

of one metal with various others—*e.g.* AuAg, AuCu, etc.—which is only approximately true. The theory is also developed to explain the variation of resistance with temperature, the expression evolved agreeing with experimental figures for AuAg and PdPt. From the results the number of electrons, speed of electrons and mean free path may be calculated.
B. W. C.

2352. *Effects of Certain Elements on the Electrical Resistivity of Copper.* **A. L. Norbury.** (Inst. of Metals, J. 33. pp. 91–94; Disc., 94–95, 1925.)—Copper alloys consisting of α solid solutions were drawn to 0·1 in. diameter wires and the resistivity determined in the " as received " and annealed states. Aluminium, silicon, manganese, nickel, zinc, silver, tin and cadmium were used. The results showed that cadmium was the best hardener for copper, and the effects of both zinc and cadmium on the resistivity were similar.
F. J. B.

2353. *Resistance Changes of a Platinum and Iron Wire in High Vacuum in Relation to their Gas Content.* **H. Kleine.** (Zeits. f. Physik, 33. 5–6. pp. 391–407, 1925.)—Previous work on this subject by Knott, Krackau, Fischer [see Abstract 1615 (1906)], v. Pirani, Meyer, Siebel, Suhrmann and Schirmann is first reviewed. Experiments with full details are then described for preliminary work with iron wire and an extended investigation with platinum wire, both in high vacuum and in the atmosphere. For both metals the resistance changes were in the same sense, *viz.* gas evolution or absorption corresponds to decreased or increased resistance respectively. The resistance changes appear to be in linear relationship to the gas content and correspond to 1×10^{-4} ohm for a gas-content change in iron wire of about 5×10^{-4} parts by volume and for platinum wire of 2×10^{-2} parts by volume, the gases having been determined volumetrically. The resistance of platinum wire decreased linearly to about 12 % when maintained at the glow for 1200 min. Resistance changes in iron wire could only be produced by means of alterations in pressure. With platinum wire previously glowed in hydrogen, changes in resistance were only attained by strongly heating in the high vacuum. The temperature coefficient for platinum wire was investigated for a temperature range of 16–45° C., but no conclusions could be drawn with respect to the influence of the gas content.
H. H. Ho.

2354. *The " Throttle Cross " in Vacuum.* **C. Benedicks** and **G. Phragmén.** (Ark. f. Mat. Astron. och Fysik, Stockholm, 19b. No. 4. pp. 1–6, 1925. In German. Phys. Zeits. 26. pp. 434–436, July 21, 1925.)—The authors describe an experiment to measure the thermoelectric effect in an asymmetrically heated homogeneous conductor [Benedicks' effect, Abstract 984 (1918)] when the same is situate *in vacuo*. The material used was Acheson graphite and the cross-arrangement " Drosselkreuz " [Abstract 1369 (1917)] was employed, which gives a steep temperature gradient at the crossing, thereby enhancing the effect. E. Rumpf [Abstract 638 (1924)] has observed that with copper the effect diminishes with the lowering of the surrounding air-pressure, and ascribed the effect to a surface phenomenon (gas occlusion), but later he withdrew this explanation [Abstract 152 (1925)] owing to the fact that he had assumed the temperature gradient the same under the varying conditions. The arrangement adopted by the present authors enables them to measure the temperature difference between the ends of the cross-pieces, which are about 1 cm. from the overlapping portions, and to compare the e.m.f.'s for the same temperature differences of these ends. At ordinary atmospheric pressure and an end temperature difference of 18° the e.m.f. in the homogeneous circuit is $1 \cdot 2 \times 10^{-4}$ volts. When the pressure is reduced to 10^{-5} mm. Hg the e.m.f. observed for 18° difference is 1×10^{-4} volts. The curve connecting e.m.f. and temperature difference (*in vacuo*) is of the third degree, which is characteristic of this phenomenon, and establishes definitely that it cannot be ascribed to surface effect. L. L.

2355. *Effect of Light on the Thermoelectric Power of Selenium.* **R. M. Holmes.** (Phys. Rev. 25. pp. 826–834, June, 1925.)—To show the effect of light, pure selenium is melted on ground-glass slides provided with nickel electrodes 6 cm. long and 2 mm. apart. The amorphous material is converted into the grey crystalline form. A temperature gradient is established in the selenium by means of two copper blocks clamped to the nickel electrodes and kept at different constant temperatures. The thermal e.m.f. and resistance are measured for various illuminations with white light, the former by a compensation method, using an electrometer as a null instrument. Light causes a decrease of about 5 % in thermoelectric power, corresponding to an increase of about 500 % in conductivity. These effects of light may be explained according to the electron theory by assuming an increase in the mean free path of conducting electrons caused by a decrease in the potential energies of electrons in interatomic space. It is pointed out that in a circuit entirely of selenium, homogeneous in every respect except that two sections have temperature gradients of opposite sign, if one section is illuminated a large thermal e.m.f. will be developed in the circuit. The dark values for different samples is found to be between 0·99 and 1·14 millivolts per degree against copper. A. E. G.

2356. *Axial Galvano- and Thermo-magnetic Effects.* **A. Sellerio.** (Zeits. f. Physik, 32. 10. pp. 742–745, 1925.)—L. L. Campbell, in his recent book on "Galvanomagnetic and Thermomagnetic Effects" (Longmans' Monographs on Physics), considers the axial effects described by Sellerio [Abstract 2498 (1923)] need further investigation before they can be considered as distinct phenomena and not as due to asymmetry of the lines of force with respect to the plate. In the present paper the author summarises the evidence, theoretical and experimental, for regarding the effects he has previously described as truly axial. L. L.

2357. *Dielectric Constants of Liquids.* **H. Harris.** (Chem. Soc., J. 127. pp. 1049–1069, May, 1925.)—Alternating current bridge methods of determining the dielectric constants of liquids are investigated, and, using a method which is claimed to give greater accuracy than has previously been attained, the following values are found at 25° C.: Benzene, 2·2482; carbon tetrachloride, 2·219; chloroform, 4·6417; ethylene dichloride, 10·131; *o*-nitrotoluene, 26·066; nitrobenzene, 34·093. G. A. S.

2358. *Effect of Pressure on the Dielectric Constant of Organic Liquids.* **M. Grenacher.** (Ann. d. Physik, 77. 2. pp. 138–158, July, 1925.)—

The effect of pressure on the dielectric constant of various organic liquids is measured by a compensation method using an air condenser and a specially constructed vibrating needle galvanometer which is more readily adjustable, more sensitive and easier to read than usual types. With ether and chloroform pressures up to 60 atmos. have considerable effect on the dielectric constant; nitrobenzene, nitrotoluene, brombenzene and toluene, benzene and carbon-tetrachloride also appear to be affected, but as the compressibility of these liquids is not known accurately the results are not very definite. B. W. C.

2359. *Dielectric Constants of Electrolytes.* **P. Walden, H. Ulich** and **O. Werner.** (Zeits. phys. Chem. 116. pp. 261–290, June 15, 1925.)—By means of a high-frequency resonance apparatus described in earlier work [Abstract 1730 (1925)] measurements are made of the dielectric constants of a large number of liquids chosen to cover a wide range of values, which vary from that of 4·94 for chloroform to 80·5 for water. The temperature employed is 20° C. and the wave-length 4·4 metres. Other solvents measured are chlorbenzene, ethyl aniline, aniline, *o*-dichlorbenzene, tetrachorethane, ethylene chloride, pyridine, *m*-nitrotoluene and water. The solutes employed include alkyl-substituted derivatives of ammonium halides, nitrate and picrate, while with water measurements are also made with a number of binary salts, such as potassium chloride. Curves are plotted giving the cube root of the concentration against the dielectric constant. In all cases a fall of the dielectric constant proportional to the concentration is observed at low concentrations, giving a rectilinear arm of the curve with a minimum value beyond which the dielectric constant increases with the concentration. The rising part of the curve varies with the different solutions. With aqueous solutions, on account of the limited solubility of the salts employed, only the descending part of the curve has been so far realised. The slope of the downward curve as well as the position of the minimum varies with the dielectric constant of the solvent according to expressions which are formulated.

The bipolar theory of Debye is applied to explain the descending arms of the curves, while the ascending portions are attributed to the formation of ionic complexes and aggregates. A parallelism is traced between the position of the minima for conductivity and dielectric constants. J. N. P.

2360. *The Electrolytic Interrupter.* **J. A. Crowther** and **R. J. Stephenson.** (Phil. Mag. 50. pp. 86–96, July, 1925.)—After a brief introduction and description of apparatus used, the following are the points considered: (1) Current-voltage curves for conduction through an electrolyte with a point anode; (2) phenomena at the point; (3) application of the results to the action of the interrupter; (4) evidence from the oscillographic records of current and voltage. It is concluded that in the absence of any theory to account for the high resistance developed at the point it is desirable to record the experimental results obtained without any adjustments or corrections. It is pointed out that the voltages measured are those across the terminals of the interrupter, whereas in all probability the deciding factor is the fall of potential between the point anode and some point in the electrolyte close to it. Since there is always some current flowing in the interrupter, this will be less than the p.d. between the terminals by the p.d. required to drive this current through the remainder of the electrolyte, which in turn depends on its specific resistance. It is possible that the observed differences between different electrolytes—and in particular the differences observed between different solutions of the same electrolyte—may be due in part to this cause. The fact that the critical voltage increases with the resistance gives some support to this suggestion. Until further evidence has been accumulated, it does not seem desirable to advance any suggestions as to the cause of the sudden increase of resistance which occurs when the critical voltage is passed, and which accounts for the action of the Wehnelt interrupter. It is natural to postulate the formation of a highly resistant layer at the anode, and the tightly clinging gas layer which is so characteristic of this high-resistance stage of the conduction presents itself as a very obvious explanation. The change in the mode of emission of the gas has, however, itself to be accounted for. It is hoped that further experiments may throw some light on the problem. A. E. G.

ALTERNATING CURRENTS AND MAGNETISM.

2361. *Transient Electric Phenomena in a Non-inductive Circuit.* **J. A. Wilcken.** (Phil. Mag. 50. pp. 71–75, July, 1925.)—Formulæ more accurate than Steinmetz's are deduced for the growth of current and potential in a non-inductive circuit, *viz.*:

$$i = 5\cdot 1\,(\epsilon^{-500t} - \epsilon^{-49500t})$$

$$e_1 = 1000\,(1 - \epsilon^{-500t}) - \frac{10i}{5\cdot 1}$$

Both current and potential reach 90 % of their final values within five one-hundred-thousandths of a second, as with Steinmetz's formulæ, but the growth of potential is seen to be proportional to the time from the beginning. The practical importance of this is discussed. G. A. S.

2362. *Systems with Disturbed Superposition.* **K. Heegner.** (Zeits. f. Physik, 33. 1–2. pp. 85–112, 1925.)—A general theory of the rising characteristic is developed, and shows that by forced vibrations with non-linear resistance losses with ascending characteristic self-excitation phenomena are not possible. As a consequence, the induction-integrals of self-excited vibrations in coils with iron cores are positive. Further, general formulæ are given for the damping reductions in iron-cored coils. Some experiments with such coils are also described. [See **Abstract 173** (1925).] E. H. B.

2363. *Remarks on the Weiss Theory of Ferromagnetism.* **R. H. de Waard.** (Zeits. f. Physik, 32. 10. pp. 789–793, 1925.)—On the basis of Langevin's theory of paramagnetism, Weiss evolved a theory of ferromagnetism which, though in many instances confirmed by experiment, is not exempt from contradictions [see Abstract 557 (1914)]. As these have not, to the author's knowledge, been hitherto considered, he proceeds to deal with them. Entirely mathematical. E. F.

2364. *Gyro-Magnetic Ratio for Magnetite and Cobalt.* **W. Sucksmith.** (Roy. Soc., Proc. 108. pp. 638–642, Aug. 1, 1925.)—The null method of measuring the gyro-magnetic ratio [see Abstract 333 (1924)] was used for magnetite, cobalt and pyrrhotite. The materials had to be used in powder form and were tightly packed in tubes of copper-foil. Two modifications of procedure were necessary, due to the small permeability of the magnetic powders. The results for $(Ue)/(2mM)$ are: *magnetite* 0·495 ± 0·024 and *cobalt* 0·515 ± 0·032, where M is the change in magnetic moment, U is the change in angular momentum, and m and e are the mass and change of an electron respectively. For pyrrhotite the effective intensity of magnetisation was too small to give results.

W. H. Ge.

2365. *Reversible Anomaly of Cupro-Nickel in the Domain of the Paramagnetic State.* **P. Chevenard.** (Comptes Rendus, 181. pp. 28–31, July 6, 1925.)—The author has previously studied a reversible anomaly of thermoelectric power of cupro-nickel, which is independent of that which accompanies the magnetic transformation of these alloys. The curves which represent the thermoelectric power show a change of direction at about 450° C., especially for alloys containing about 50 % copper. Similar anomalies occur at the same temperature in the dilatometric curve and in the curve of resistivity-temperature. The former is too small to be measured with accuracy, but the change of resistivity is now measured for various proportions of copper and nickel at temperatures from − 200° up to 1000° C. The results are given in an elaborate diagram, grouping the curves resistivity-temperature (ρ, θ) traced in oblique coordinates for 0, 10, 20, . . . 100 % copper, and the isotherms resistivity-concentration for temperatures − 200° to 1000° C. Between 400° and 500° the true coefficient of resistivity $\frac{1}{\rho}\cdot\frac{d\rho}{d\theta}$ shows a rapid increase; the amplitude of this sudden increase characterises the intensity of the anomaly studied. This amplitude is nil for pure nickel or pure copper, its maximum being for an alloy containing about 52 % copper, coinciding with the composition of the alloy CuNi. T. B.

2366. *Diamagnetism and Size of Ions.* **G. Joos.** (Zeits. f. Physik, 32. 11–12. pp. 835–839, 1925.)—Repeating the work of a previous paper [see Abstract 987 (1924)] with the aid of the newer measurements of Wills and Hector [see Abstract 1936 (1924)] of the diamagnetic properties of He, Ne and Ar, the author has calculated and tabulated the molecular susceptibilities of a number of ions. These values are in linear relation to the corresponding nuclear charges. Interpolation formulæ are suggested for the diamagnetism of the paramagnetic ions. Also the dimensions of the L and M orbits are calculated, and are in good agreement with those found from the crystal lattice. G. E. A.

2367. *Susceptibility of Water and Paramagnetic Solutions.* **B. Cabrera** and **A. Duperier.** (J. de Physique et le Radium, 6. pp. 121–138, April, 1925.)—To elucidate the physical meaning of the constant Δ in the Curie-Weiss equation $\chi(T + \Delta) = C$, the susceptibility, χ, of water is measured at different temperatures by means of a torsion method with a non-uniform magnetic field. It is found that $-\delta\chi/\chi = [1{\cdot}67 + 0{\cdot}0016(t - 20)](t - 20) + 10^{-4}$ between 20° and 80° C. The variation is caused by the breaking up of polymerised molecules, since, by adding diamagnetic magnesium chloride to diminish the number of polymerised molecules, $\delta\chi/\chi$ tends to zero. In a second part, solutions of manganese and nickel are studied. It is concluded that, in all the cases, the Curie-Weiss law is satisfied by values of Δ, which are, to the first approximation, independent of the anion and of the concentration. The presence of the constant Δ is attributed to a deformation of the surface layer of the paramagnetic atom under the action of other atoms chemically combined with it, *e.g.* molecules of water, in the case of solutions. G. E. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2368. *Natural and Artificial Sunlight in Health and Disease.* **C. W. Saleeby.** (Illum. Eng., London, 18. pp. 179–181; Disc., 181–184, July, 1925.)—Sketches the history of heliotherapy and emphasises the distinction between it and artificial phototherapy. The necessity for control of the practice of both, particularly the latter, is pointed out. J. W. T. W.

2369. *Constant Voltage High-tension Generators.* **C. E. S. Phillips.** (Brit. J. of Radiology, 21. pp. 91–100; Disc., 100–103, July, 1925.)—Deals in a general manner with the advantages of exciting the X-ray tube by a source of constant potential. A French apparatus, in which high-tension alternating current is rectified by means of valve tubes, is then illustrated and also various German appliances excited by transformers or induction coils and rectified either by valves or rotating switches.

A discussion followed, but added no new facts. B. J. L.

2370. *The Organisation and Equipment of X-Ray Rooms arranged for Private Radiologists.* **R. C. Rodgers.** (Brit. J. of Radiology, 21. pp. 124–133; Disc., 133–134, July, 1925.)—Reference is made to the generally recognised requirements of an hospital X-ray department. The author shows how he has endeavoured to adapt the ideal requirements to the private X-ray installation installed in a normal dwelling. B. J. L.

2371. *Acute X-Ray Burns.* **G. T. Loughborough.** (Brit. J. of Radiology, 21. pp. 135–137; Disc., 137–140, July, 1925.)—Various cases, including the author's own case, of X-ray burns are mentioned. Practical suggestions of lessening the risk of burning are given.

A discussion followed in which the application of scarlet-red, or cycloform, or amido-azo-toluol for X-ray burns is recommended. B. J. L.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2372. *Electrical Theory of Adsorption.* **B. Ilin.** (Zeits. f. Physik, 33. 5–6. pp. 435–469, 1925.)—The theory of adsorption is developed by assuming that the power of adsorption is electrical and that the energy of the adsorption field U can be expressed by the classical formula

$$U = S\int_0^2 \epsilon E^2/8\pi dx$$

A relationship between the adsorption constant (heat of adsorption Q and the adsorption capacity A), the dielectric constant ϵ, and the surface energy (surface-tension U_1/S) is shown by the equations

$$Q = \overline{E}_0^2/8\pi \cdot \frac{\epsilon_0 - 1}{TN_0} \quad \text{and} \quad \frac{U_1}{S} = Q \cdot N_0 \cdot \epsilon \cdot N_0'/\epsilon_0 - 1$$

It is shown also that a parallel exists between the adsorption constant and the attraction constant of the van der Waals equation. A method is given for calculating the adsorbing surface of 1 gramme of carbon. The order of magnitude of the surface is 10^5 cm.^{2}. F. J. B.

2373. *Relationships existing between Hydrogen and Palladium.* **B. Lambert** and **S. F. Gates.** (Roy. Soc., Proc. 108. pp. 456–482, July 1, 1925.)—Results are given of an investigation on the pressure-concentration equilibria of the system hydrogen-palladium more thorough than any previously published, the equilibrium pressures being approached in different ways. The ascending and descending pressure-concentration isothermals are profoundly affected by interruptions of the smooth addition or withdrawal of the gas, by variations in the amounts of hydrogen added between the establishment of successive equilibrium points, and by temporary cooling of the system. The conclusion is drawn that metallic palladium exists in at least two allotropic forms, which would differ in the rate at which they can absorb hydrogen and possibly in their intrinsic absorptive powers for hydrogen. In any given sample of the metal the relative proportions of the different allotropes may be altered by the addition of hydrogen or by the withdrawal of gas from metal containing hydrogen. T. H. P.

2374. *Surface Solutions and Gay-Lussac's Law.* **A. Marcelin.** (Comptes Rendus, 180. pp. 2022–2023, June 29, 1925.)—Results similar to those obtained with oleic acid [Abstract 2610 (1924)] are given by surface solutions of benzyl benzoate. Evidently the constant K of the formula $pS = KT$, expressing the obedience of surface solutions to Boyle and Gay-Lussac's laws, differs widely and in a manner characteristic of the substance, and probably of the medium, from the universal constant R of gases and solutions. Attention is directed to the fact that the molecules of surface solutions are semi-dissolved and, on the surface of water, certainly polarised. T. H. P.

2375. *Extension of Gay-Lussac's Law to Surface Solutions.* **R. Delaplace.** (Comptes Rendus, 180. pp. 2024–2026, June 29, 1925.)—Further experiments with benzyl benzoate [see preceding Abstract] show that the nature of the solvent and the concentration are without influence on the value of K, which is about one-sixtieth of that of the gas constant R. The possibility of entrainment of benzyl benzoate into the water by solvents of different solubilities is also excluded. Investigation of the manner in which a soluble or volatile compound—such as alcohol, ether, etc.—disappears from the surface of water shows that a surface pressure is established at first and is annulled only after some minutes; ether does not dissolve completely and leaves a residue exerting a constant surface pressure of 0·022 dyne-cm. When a known amount of benzyl benzoate is dissolved in one of these solvents, the surface pressure is not annulled, the constant residual pressure being a measure of the surface pressure of benzyl benzoate spread on water. T. H. P.

2376. *The Influence of Pressure on the Solubility of Substances. Part V. The System Naphthalene-Tetrachlorethane.* **E. Cohen, W. A. T. de Meester** and **A. L. T. Moesveld.** (K. Akad. Amsterdam, Proc. 28. 2. pp. 108–118, 1925.)—In an earlier investigation [Abstract 1478 (1923)] on the influence of pressure on the solubility of thallium sulphate in water it was found that the relation could be represented by a parabolic curve. The existence of a minimum in the solubility was thus shown to be possible, though this fell beyond the range of pressures employed. In the present work the relation is investigated by employing solutions of naphthalene in tetrachlorethane which give a large volume change. A shaking bomb is employed of a type similar to that used in the earlier work. When the solution equilibrium is reached under pressure, the saturated solution is forced from a glass vessel in the bomb into pipettes, and from these the solution, saturated at 30° C. and p atmospheres, is pressed into a pycnometer in order to determine the specific volume of the solution. The concentration is calculated by means of an equation giving the relation between specific volume and concentration. Concordant results are obtained up to pressures of 1000 atmos. and are in agreement with the expression $\log c = 1{\cdot}61764 - 0{\cdot}24196 \,.\, 10^{-3}p + 0{\cdot}03432 \,.\, 10^{-6}p^2$, where c is the percentage molecular concentration. According to this relation a minimum of solubility occurs at a pressure of 3500 atmos., and accordingly could not be established experimentally. J. N. P.

2377. *The Influence of Emulsoids upon the Rate of Dissolution of Zinc in Solutions of Lead, Nickel and Copper Salts.* **J. N. Friend** and **J. S. Tidmus.** (Inst. of Metals, J. 33. pp. 19–25, 1925.)—On the assumption that the retardation of the corrosion of metals in salt solutions by the presence of emulsoids is due to the adsorption of the emulsoid on the solid surface, an investigation is made of the applicability of an adsorption law of the form $R = k\sqrt[n]{C}$, where k and n are constants, C is the percentage concentration of the emulsoid in the liquid medium after equilibrium between the solution and solid surface has been attained, and R is the relative retardation. An approximately straight line relation is obtained on plotting log R against log C with most reactions with dilute emulsoid solutions, indicating that the adsorption is the chief factor concerned. In the dissolution of zinc and iron in salt solutions containing various emulsoids it is found that in all cases, except with gelatin in nickel sulphate and lead acetate solutions, the order of efficiency of the emulsoids examined in retarding solution is as follows: agar, gelatin, acacia and sucrose, the last having in general but little action.

The rate of solution increases rapidly with concentration and with temperature. In the solution of zinc in copper sulphate the retarding action of the agar falls off rapidly with rise of temperature above 15° C. [See Abstract 2616 (1924).] J. N. P.

2378. *The Constitution of Soap Solutions in Presence of Electrolytes, Potassium Laurate and Potassium Chloride.* **W. C. Quick.** (Chem. Soc., J. 127. pp. 1401–1411, June, 1925.)—Determinations are made of the transport of each of the constituents of a solution containing potassium laurate and potassium chloride during electrolysis. It is inferred from the values obtained that the undissociated soap (neutral colloid) scarcely moves in this solution, and the ionic micelle does not contain appreciable quantities of the undissociated soap. This confirms previous work showing that the ionic micelle is a hydrated colloidal aggregate of simple fatty ions. From the migration numbers it is estimated that three-fifths of the total current is carried by potassium chloride, the remaining two-fifths being carried by ionised soap (ionic micelle). From these data, in conjunction with measurements of conductivity and of dew-point lowering, it is estimated that the hydration of potassium laurate in normal solution, where it is entirely colloidal (neutral colloid and ionic micelle) amounts to 12·8 molecules of water per equivalent of laurate, which is in agreement with earlier determinations by independent methods. J. N. P.

2379. *Decomposition Potentials of Solutions of Metal Bromides in Molten Aluminium Bromide.* **W. Isbekow.** (Zeits. phys. Chem. 116. pp. 304–312, June 15, 1925.)—Measurements are made of the decomposition voltages of a number of metal bromides dissolved in molten aluminium bromide at temperatures of from 100° to 200° C. The electrolysis vessel consists of smooth platinum wires mounted in a glass tubular vessel. A measured and graded potential is applied and the point noticed at which an appreciable rise in the current occurs. It is ascertained that changes in the concentration produce only small variations in the separation potentials. With mercuric bromide a rise in the current voltage curve occurs at 0·40 volt, due to the production of $Al_2Br_6 . HgBr^+$ ion. A fall then follows at a higher voltage, due to the separation of slightly soluble HgBr at the kathode, which decomposes at 0·96 volt to give a second and continuous rise in the curve. The potential series of the metals in aluminium bromide, beginning with the least noble, is found to be: Al, Zn, Cd, Ag, Hg, Sb, Bi, which in the case of the last four elements, and particularly in that of silver, shows a noteworthy difference from the order in aqueous solution. The order of this series is further confirmed by the ability of each metal of displacing a succeeding one from solution in this electrolyte. The order is shown to be the same as that of the heats of formation of the bromides, and indicates that the temperature coefficient dE/dT in the Helmholtz equation is in all these cases low. J. N. P.

2380. *The Effect of Light on the Settling of Suspensions.* **C. G. T. Morison.** (Roy. Soc., Proc. 108. pp. 280–284, June 2, 1925.)—Preliminary observations on the stratification of soil suspensions after exposure to light. W. V. M.

2381. *Studies in Emulsions.* **W. Seifriz.** (J. Phys. Chem. 29. pp. 834–841, July, 1925.)—Experiments are described in which it is found that olive oil emulsions, with one of a variety of stabilisers (soap), are reversible with $BaCl_2$ and also with HCl. A pH value of 7·2 is always that at which reversal takes place with HCl and frequently with $BaCl_2$. These facts suggest that H-ion concentration is a factor in the phase reversal of emulsions. The further facts (that two hydroxides, each adding to the alkalinity of an emulsion, may cause reversal in opposite directions, and that highly alkaline emulsions of the oil-in-water type may be reversed by $BaCl_2$ without bringing the pH value even to approach 7·2) preclude ascribing to acidity any prime rôle in determining type or reversibility in emulsions. The study of six different vegetable oils shows that they are all of one class, both as regards type of emulsion originally formed and the reaction to electrolytes. In type they resemble the light petroleum oils, from which they are quite different as to behaviour in the presence of electrolytes. A. B. C. L.

2382. *Velocity of Ice Crystallisation through Supercooled Gelatine Gels.* **E. H. Callow.** (Roy. Soc., Proc. 108. pp. 307–323, June 2, 1925.)—Detailed experimental investigation is made of the effects of gelatine concentration, H-ion concentration and salt content on the velocity of ice crystallisation in gelatine gels at − 3° C. Crystallisation in the supercooled gels is started by seeding with ice. Increase of gelatine concentration causes decrease of velocity of ice crystallisation. The decrease is considerable for concentrations above 1 %. When the H-ion concentration is varied by means of HCl, the crystallisation velocity shows a minimum at the iso-electric point of gelatine and a maximum about pH2·6. With H_2SO_4 the maximum is only half that obtained with HCl. NaOH also increases the crystallisation velocity, the curves for 4 % gels containing varying quantities of HCl, H_2SO_4, and NaHO showing a striking resemblance to those obtained by Loeb for the swelling of gelatine. Neutral salts cause a slight increase in the crystallisation velocity, NaCl behaving exceptionally, as also recorded by Loeb in connection with the swelling, etc., of gelatine. Abnormally high results are obtained for the crystallisation velocity through gels containing less than 2·5 % gelatine in the region of the iso-electric point, these anomalies being correlated with the degree of turbidity. β-gelatine does not retard crystallisation to the same extent as normal gelatine. A. B. C. L.

2383. *Reduction Velocity and the Growth of Small Gold Particles in the Preparation of Colloidal Gold Sols.* **R. Zsigmondy** and **E. Hückel.** (Zeits. phys. Chem. 116. pp. 291–303, June 15, 1925.)—In the reduction of gold salts by formaldehyde solutions a marked increase in the rate of reaction occurs with time, which is attributed to the increase of surface of the gold particles. Measurements are made by allowing the solution to react in presence of a previously prepared suspension of gold particles and comparing the sol optically with standard preparations. An expression deduced theoretically for the rate of reaction on the assumption of surface catalysis is of the form $y = b/a[(1 + 2kt/l_0)^3 - 1]$, where y is the ratio of the amount of gold reduced in the time t to the amount originally present as ions, a is the volume of the reacting mixture taken and b the volume of gold sol added as catalyst, l_0 is the initial length of the gold particles assumed to be present as uniform cubes, k is the linear rate of growth in one direction of the particles in cm./sec. In accordance with this relation, which assumes that the number of particles originally present is large compared with the number of new ones which are formed by the reaction, the rate of reaction at a given temperature is proportional only to the number of particles present and independent of the ionic concentration of gold. For a given mass of gold particles the reduction is inversely proportional to their size or proportional to their number. The relation is found to be approximately followed in cases where the gold sol is sufficiently concentrated and where the rate of reaction is not too high. J. N. P.

2384. *Explanation of the so-called Intertraction Phenomenon between Solutions and the Molecular Significance of Negative Surface-tension.* **N. K. Adam** and **G. Jessop.** (Roy. Soc., Proc. 108. pp. 324–331, June 2, 1925.)—The streamers or "pseudopodia" observed by Wright and Schoneboom [see Abstract 383 (1923)], when certain solutions are superimposed on other solutions, are further experimentally studied. The results obtained from fifteen pairs of substances, selected to give a wide range of diffusion coefficients and to be as various as possible in chemical properties, show that streaming or "intertraction" is observed only when the more slowly diffusing solution is uppermost and when the difference in density is not greater than about 0·05. It is concluded that surface-tension has nothing to do with the phenomenon, and a simple explanation is developed involving as essential factors the difference in the rates of diffusion of the solutes in the two solutions and the direction of gravity. In remarking upon the phenomena of negative surface-tension, it is argued that there is no justification for the assumption of a molecular structure at the surface of a liquid which can be regarded as a contractile skin, producing the surface-tension. A. B. C. L.

2385. *Spectrographic Study of Mercury Complexes.* **P. Job.** (Comptes Rendus, 180. pp. 1932–1934, June 22, 1925.)—A continuation of previous work [see Abstract 1762 (1925)] and a study of the reaction $HgCl_2 + 4KBr$. It is shown that the other member of the equation expressing this reaction is $|HgBr_4|K_2 + 2KCl$. Similarly it is found that

$$HgCl_2 + 4KI \rightleftarrows HgI_4 . K_2 + 2KCl$$

Other reactions have also been studied. It is pointed out that the formation of a complex is indicated only if the position of the absorption maximum is unaffected by a change in the concentration.

J. W. T. W.

2386. *Cementing of Iron Alloys by Chromium.* **J. Laissus.** (Comptes Rendus, 180. pp. 2040–2043, June 29, 1925.)—To diminish oxidation at high temperatures and corrosion from acids, particularly HNO_3, examination was made of the effect of initial treatment of the alloy. It was found necessary for this treatment to be carried out at a temperature exceeding 1100° C. An eutectic was then formed and its presence indicated by the appearance of a brilliant external colour, probably a carbide of Cr. Changes in the composition of the alloy and the cement showed that this constituent developed more rapidly at higher temperatures in a steel containing less carbon and with the Fe-Cr cement more pure. R. S. R.

2387. *The Application of X-Rays to the Study of Alloys.* **H. Weiss.** (Roy. Soc., Proc. 108. pp. 643–654, Aug. 1, 1925.)—Deals with the factors on which the precision of the measurements depends and with the preparation of the specimens so as to obtain crystals of the right size, giving uniform sharp lines. Measurements with α-bronze show that the size of the lattice increases with addition of tin more rapidly than a linear law requires. Measurements of density suggest that one atom of tin takes the place of several atoms of copper. An investigation with silver-gold alloys shows that the size of the cell varies continuously except for the experimental errors of about 0·1 %; there is no trace of the sudden increases of size observed by McKeehan. Irregular shrinkage of the film reduced the accuracy to about 0·1 %. To obtain greater accuracy it would be necessary to use glass plates or to print a scale on the film by the use of suitable marks on the camera. H. N. A.

2388. *Annealing of Electrolytic Iron in a Vacuum.* **R. Hugues.** (Comptes Rendus, 180. pp. 2043–2045, June 29, 1925.)—Tests were carried out in a special form of electric furnace having double walls of quartz, with the heating coil in an evacuated annular space between the walls at a pressure of 2 mm. and the outside of the furnace cooled by water circulating in a coil. In this way the gases expelled from the alloys during heating could be collected and the errors due to porosity of the quartz or leakage at the joints avoided. Values were obtained for the composition of the escaping gases, and the volume of gas escaping at different temperatures, and for the magnetic, mechanical and micrographic properties of different samples. This process gives in every way better results than similar treatment in a normal atmosphere. R. S. R.

2389. *Review Lectures on the Theme: Inelastic Atomic and Molecular Impact.* **M. Bodenstein, J. Franck.** (Zeits. Elektrochem. 31. pp. 343–350 and 350–357; Disc., 357–359, July, 1925. Papers read before the Deut. Bunsen Gesell., Darmstadt, May, 1925.)—The first lecture given by Bodenstein reviewed the present position of the basis of chemical kinetics from the chemist's standpoint; the second, by Franck, dealt with the subject from the physicist quantum view-point. The nature and continuity of the two lectures necessitates their being read in the original, as an abstract could not do justice to their excellence. H. H. Ho.

2390. *Equilibrium Principle of G. N. Lewis.* **M. Leontowicz.** (Zeits. f. Physik, 33. 5–6. pp. 470–474, 1925.)—The principle of equilibrium stated by G. N. Lewis, *viz.* "For every elementary process there exists an inverse reaction, and in the condition of equilibrium the mean reaction velocity of each process is equal to that of the inverse process" [see Abstract 1766 (1925)], is mathematically treated and the limits of its application investigated. The relationship of the principle to Einstein's development of Planck's law of black body radiation was analysed. F. J. B.

2391. *Calculation of Specific Affinity.* **T. de Donder.** (Comptes Rendus, 180. pp. 1922-1924, June 22, 1925.)—In a preceding note [see Abstract 2183 (1925)] the author has defined the specific affinity of a system for any phase in terms of the fundamental potentials H, F, ψ and ν, the characteristic equation being $p = p(\nu, T, \xi)$. The method of calculating F (the free energy) is to assume that as ν^0 tends towards infinity, the entropy $S(\nu^0, T, \xi)$ tends towards the entropy of a perfect gas at the same temperature and of similar chemical constitution, the specific affinity behaving in like manner. The general formula giving the free energy of the system is then written :

$$F = F^*(\nu, T, \xi) - \int_{\nu^0(T\xi)}^{\nu} [p(\nu, T, \xi) - p^*(\nu, T, \xi)]d\nu$$

where * stands for the corresponding perfect gas values. The specific affinity is then given as—

$$(\text{sp. affin. of perfect gas}) + \partial/\partial\xi \int_{\nu^0(T\xi)}^{\nu} (p - p^*)d\nu.$$

Several particular examples are included. H. H. Ho.

2392. "*Note on Garner's Paper on the Critical Increment of Chemical Reactions.*" **C. N. Hinshelwood.** (Phil. Mag. 50. pp. 360–361, Aug., 1925.)—Experimental evidence shows that P (a factor expressing the probability that a collision between activated molecules results in the formation of the reaction products rather than in the separation of the two molecules in a chemically unchanged state) is of the order of magnitude unity, and Garner argues [see **Abstract 1517 (1925)**] that P cannot be exactly unity. He also suggests that since P itself is an unknown function of temperature, the method of determining Q (the heat of activation) from the effect of temperature on the reaction velocity is unsound. The author states that unless he has misunderstood Garner's argument, the criticism is not valid, and he puts forward the alternative view : Temperature has no meaning applied to individual molecules, and defines the statistical distribution of energy among large numbers of molecules. Activated molecules are those with specified energies, and temperature determines how many of these exist and how many collisions take place between them. Whether a collision between two individual molecules with specified energies is "elastic" or "inelastic" in the chemical sense cannot depend upon the distribution of energy among other molecules which are not participating in the impact. Thus P would seem to be independent of temperature. Activated molecules have always the same temperature, whatever the real statistical temperature of the gas may be, because they are *ex hypothesi* molecules of specified energy.

H. H. Ho.

2393. *The Two-Stage Transformation of Magnetite into Hematite.* **L. A. Welo** and **O. Baudisch.** (Phil. Mag. 50. pp. 399–408, Aug., 1925.)—Magnetite (Fe_3O_4) can be completely oxidised to ferric oxide (Fe_2O_3) at 220° C. The maximum permeability may increase from 2·93 to 3·39 during the transformation. If ferric oxide be heated in a neutral atmosphere—*e.g.* nitrogen—at about 550° C. the maximum permeability falls to 1·045. The necessary condition for this purely thermal effect is that the ferrous iron in Fe_3O_4 be first oxidised to the ferric form. Change of crystal structure does not occur until a temperature of 550° C. is attained, so that Fe_2O_3 may have two structures. It is shown that more oxygen can be accommodated in the atomic arrangement of magnetite without undue strain on the structure. J. S. G. T.

2394. *Mechanism of the Photochemical Reaction between Hydrogen and Chlorine.* **A. L. Marshall.** (J. Phys. Chem. 29. pp. 842–852, July, 1925.)—To test Nernst's assumption that the primary action of light is the dissociation of a Cl molecule experiments are devised in which atomic H is led into a stream of Cl at low pressures. Values ranging from 1 molecule of HCl per H atom at 0·004 cm. pressure to 7 molecules per atom at 0·60 cm. pressure are obtained. Possible objections to the Nernst mechanism for the photochemical reaction between H and Cl are discussed and a method is suggested for a direct experimental test. The results obtained are interpreted by a mechanism involving excited Cl molecules. A. B. C. L.

2395. *The Mechanism of Catalytic Decomposition.* **F. H. Constable.** (Roy. Soc., Proc. 108. pp. 355–378, June 2, 1925.)—When alcoholic substances at temperatures below 280° C. react at copper surfaces, only the $-CH_2OH$ group is changed. It appears certain, moreover, that the only molecules which react are those which have the $-CH_2OH$ group in contact with the copper. Hence the velocities of dehydrogenation of all primary alcohols are equal. The mechanism of the change is the loss of neutral H atoms, the energy of activation becoming the energy of oscillation of the H atom of the hydroxyl group. An equation deduced on these lines leads to the idea of "reaction centres," where the adsorbed alcohol molecule is situated over some characteristic group of copper atoms. Application of the theory of probability to the problem of the centre of activity shows that the proportional frequency of centres with heat of activation ϵ is connected with ϵ by an exponential relation. The reaction-velocity expression deduced takes the form

$$v = C_T \cdot S \cdot e^{h\epsilon_1} \cdot e^{-\epsilon_1/RT}/(h - 1/RT)\sigma$$

where $S =$ area of copper surface; $\epsilon =$ minimum energy necessary for the H atom to oscillate from the alcohol molecule to the copper surface; $\sigma =$ mean life of molecule in the layer next to the catalytic surface; $T =$ mean temperature of reacting film; $C_T =$ the modulus in normal law of errors; $h =$ the distribution constant. T. B.

2396. *The Effect of Poisonous Substances and Mixed Vapours on Catalytic Activity.* **F. H. Constable.** (Cambridge Phil. Soc., Proc. 22. pp. 738–750, July, 1925.)—An investigation is made of the dehydrogenation of ethyl and isoamyl alcohols in accordance with the equations:

$$C_2H_5OH \rightarrow CH_3CHO + H_2$$
$$C_5H_{11}OH \rightarrow C_4H_9CHO + H_2$$

in presence of a copper gauze catalyst. Activation of the surface was effected by alternate oxidation and reduction a number of times. With amyl alcohol the reaction velocity decreases with time owing to poisoning due to traces of impurity in the alcohol. The activity of the catalyst, poisoned by amyl alcohol, fell with time in accordance with the simple logarithmic law $\log v = -kt + c$. Confirmation is obtained that the rates of dehydrogenation of ethyl and amyl alcohols are equal. The temperature coefficient of dehydrogenation on the catalyst is unchanged through the poisoning, though the reaction velocity is reduced thirty times. The coefficient is also shown to be unchanged during sintering, the reaction velocity being reduced ten times. The heat of activation is deduced from

the temperature coefficient. Equations are derived for the rate of poisoning of an exponential distribution of centres of activity when the poison attacks the more active centres selectively. The relation deduced cannot usually be distinguished (except with special relations between the constants) from the simple logarithmic law of poisoning. An equation is derived to express the reaction velocity as a function of time and temperature, and gives adequate explanation of previous experimental results on the forms of the heating and cooling curves with " poisonous " alcohols.
J. N. P.

2397. *Relation of Homogeneous to Catalysed Reactions. The Catalytic Decomposition of Hydrogen Iodide on the Surface of Gold.* **C. N. Hinshelwood** and **C. R. Prichard.** (Chem. Soc., J. 127. pp. 1552–1559, July, 1925.)—A heterogeneous catalyst may influence a reaction in two ways: It may modify the mechanism of the chemical change by allowing it to proceed along another path; it may also facilitate the transformation by lowering the energy of activation, *i.e.* the energy which must be imparted to the reacting molecules before they can be transformed chemically. There is good evidence that in homogeneous chemical changes this energy of activation is the quantity which plays the decisive part in determining the rate of reaction at a given temperature. It was shown that the thermal decomposition of hydrogen iodide on the surface of a heated gold wire is a catalytic reaction, the rate of which is almost independent of the pressure of the gas and uninfluenced by the presence of hydrogen. It was shown that when reactions are considered which are homogeneous thermal decompositions—such as nitrous oxide, hydrogen iodide and ammonia, heterogeneous decompositions of nitrous oxide on platinum and gold, of hydrogen iodide on gold, and of ammonia on tungsten—the surface reaction have heats of activation only half as great as those of the bimolecular homogeneous changes. In some cases it has been shown that the surface changes involve only one molecule, and this is probably a general rule. The function of the surfaces in the reaction considered is to permit the occurrence of a unimolecular process instead of a bimolecular process, requiring an energy of activation about twice as great. F. J. B.

2398. *Interaction of Carbon Dioxide and Hydrogen on the Surface of Tungsten.* **C. N. Hinshelwood** and **C. R. Prichard.** (Chem. Soc., J. 127. pp. 1546–1552, July, 1925.)—The rate of the reaction $H_2 + CO_2 = H_2O + CO$ on the surface of the tungsten filament heated to a temperature of 1000° to 1300° C. was determined. It was found that the rate was proportional to $\sigma_{H_2}, \sigma_{CO_2}$, where σ_{H_2} and σ_{CO_2} are the fractions of certain active parts of the surface which are covered with adsorbed hydrogen and adsorbed carbon dioxide respectively. The adsorption of each gas on the active centres is almost independent of the pressure of the other. This indicates that the whole surface is not active, but that only certain parts are able to adsorb hydrogen and carbon dioxide and cause them to react. Interaction apparently takes place when molecules of the two gases are adsorbed on adjacent centres of the approximate kind. F. J. B.

2399. *Estimation of Chemical Equilibrium between Different Stages of Oxidation by Electromotive Force Measurements. Equilibrium between di-, tri-, and septvalent Manganese in Phosphoric Acid Solution.* **G. Grube**

and **M. Staesche.** (Zeits. Elektrochem. 31. pp. 362–371, July, 1925.)—The various stages of oxidation of manganese in phosphoric acid solution were investigated. The equilibria

$$(1)\quad 2\,\mathrm{Mn}^{\mathrm{III}} \rightleftarrows \mathrm{Mn}^{\mathrm{II}} + \mathrm{Mn}^{\mathrm{IV}}$$

and

$$(2)\quad 4\,\mathrm{Mn}^{\mathrm{IV}} \rightleftarrows 3\,\mathrm{Mn}^{\mathrm{III}} + \mathrm{Mn}^{\mathrm{VII}}$$

were found to depend upon the concentration of the manganese and the phosphoric acid. The decomposition of trivalent manganese phosphate showed a maximum in concentrated phosphoric acid, falls in 30–35 in phosphoric acid solution, and again rises on still further dilution. Tetravalent manganese phosphate is decomposed in the direction of left to right (equation (2)), with reduction in acidity. In accordance with this fact, the preparation of manganese$^{\mathrm{IV}}$ phosphate is only possible in strong phosphoric acid solutions. Under suitable conditions manganese$^{\mathrm{IV}}$ phosphate is a better oxidising agent than permanganic acid and a better reducing agent than manganese$^{\mathrm{III}}$ phosphate. F. J. B.

2400. *A Laboratory Ozoniser yielding High Concentrations of Ozone.* **L. I. Smith.** (Am. Chem. Soc., J. 47. pp. 1844–1850, July, 1925.)—A modified type of the Berthelot tube apparatus is described which gives an ozonised oxygen containing about 15 % ozone and has a capacity of over 4 grms. of ozone per hour. In order to prevent sparking it is found essential thoroughly to dry the oxygen in the ozonising space and the surface of the tubes bounding the ozonising space. The concentration of the ozone increases with the rate of flow up to a certain maximum and at higher rates of flow decreases. J. N. P.

2401. *The Action of Certain Reagents upon Ozone.* **L. I. Smith.** (Am. Chem. Soc., J. 47. pp. 1850–1853, July, 1925.)—A measurement is made of the decomposition of ozone when passed at various rates through different reagents. The reagents investigated fall into two classes with respect to their effect upon ozone: (1) those having a very small effect—to this group belong water, concentrated sulphuric acid, 5 % sulphuric acid, acidified potassium permanganate solution, and phosphorus pentoxide which has been resublimed in a current of oxygen; (2) those having a great effect, and destroying much or all of the ozone—to this group belong 5 % sodium hydroxide solution and ordinary phosphorus pentoxide. J. N. P.

2402. *Study of Displacement of some Organic Acids from their Sodium Salts by Conductivity Measurements.* **J. Bureau.** (Comptes Rendus, 181. pp. 42–44, July 6, 1925.)—The displacement of propionic and butyric acids from their sodium salts by hydrochloric acid, and of malonic acid from neutral sodium malonate glutaric acid from sodium glutarate, were studied. Hydrochloric acid was added in measured quantities to solutions of the salts and the conductivity determined after each addition. The results showed that monobasic acids can be estimated in a salt, with an error of 1 % at a dilution of 1 molecule in 400 if the affinity constant is less than 10^{-5}. Dibasic acids are feeble ($K = 10^{-5}$) and the other strong ($K = 10^{-2}$); the exact point of formation of the acid salt is indicated. F. J. B.

2403. *Gaseous Combustion at High Pressures. Part V. The Explosion of Hydrogen-Air and Carbon Monoxide-Air Mixtures at Initial Pressures* *up to 175 Atmospheres.* **W. A. Bone, D. M Newitt and D. T. A. Townend.** (Roy. Soc., Proc. 108. pp. 393–418, July 1, 1925.)—The third bomb of the authors [Abstract 1961 (1924)], capable of resisting 2000 atmos. and made of nickel-chrome steel (0·28 C, 3·26 Ni, 0·68 Cr, 0·5 Mn), cooled the gases more rapidly, being more massive than the others, but did not in its valve seatings and firing plug so well bear high excesses of oxygen. In general the time t_m taken for the attainment of the maximum pressure P_m diminished as the initial P_i was increased; the reverse held for normal CO-air mixtures, where the t_m at 175 atmos. was eight times as long—*viz.* half a second—as at $P_i = 3$. This is ascribed to the increase of the N_2 activation with P_i, which is more a pressure than a temperature phenomenon. After-burning was not observed except at low P_i (3 atmos.), never above 10 atmos. In normal H–O mixtures the amount of H_2O dissociation never exceeded (up to 175 atmos.) 1·7 %, and no activation was detected. In experiments with $(2CO + O_2 + 4\ CO)$ mixtures at 75 to 175 atmos., where the temperature was probably 2900 to 3150° C., the excess of the CO present so effectively suppressed any dissociation of CO_2 at T_m that the rate of cooling was exceedingly rapid, being above $P_i = 150$ proportional to T^4; the gaseous medium was thus in a highly radiative condition. In the experiment with $(2CO + O_2 + 4Ar)$, however, at all pressures the degree of CO_2 dissociation at T_m amounted probably to 15 to 25 %; in normal CO-air mixtures, on the other hand, this dissociation was of the order of 5 % only, corresponding to the lower T_m. The corrected P_m/P_i ratio increased in all the mixtures, notably with the P_i; that may be due to the increasing opacity of the gaseous medium with increasing pressure to the radiation emitted during the explosion. Experiments with helium mixtures and a spectrometric examination are now taken up. H. B.

2404. *Measurements of Velocity of Synthesis of Hydrogen Bromide by Capacity Change.* **A. Bramley.** (Phys. Rev. 25. pp. 858–864, June, 1925.)—A full description with diagram of the apparatus used is given. The dielectric constant of bromine vapour at 180° C. is found to be 1·0128 by comparing the capacity of the condenser containing Br with the capacity when it contained a gas of known dielectric constant. This value is considerably larger than that calculated for diatomic molecules (1·0022) and evidently corresponds to the molecular aggregate $(Br_2)_6$. In the experiments on the synthesis of HBr, by capacity measurements it is found that at 18° C., in the dark, the reaction takes place slowly if at all, but illumination by a 100-watt lamp for a few minutes produces a considerable change. Blue light is found to be about four times as effective as red. At 58° C. the reaction proceeds in the dark, the thermal effect predominating over the photochemical. A null method capacity bridge is described, similar to the regenerative detector, in which the bridge feeds back to the plate circuit. A. E. G.

2405. *Migration of Ions in Solid Electrolytes.* **M. le Blanc and M. Kröger.** (Zeits. Elektrochem. 31. pp. 359–360, July, 1925.)—The authors give a brief review of recent work on the migrations of ions in solid electrolytes, the influence of temperature and surface effects being considered, and it is held that the results obtained are more in accord with the views of the authors than with the claims of Tubandt. [See Abstract 1775 (1925).] B. W. C.

2406. *Thermodynamics of Solutions of Certain Simple Electrolytes.* **H. S. Harned.** (Zeits. phys. Chem. 117. pp. 1–50, Aug. 10, 1925.)—The general thermodynamic theory of galvanic cells is discussed, and the thermodynamics of the activity function is developed. A method of measuring the e.m.f. of cells with streaming amalgams as electrodes is described, and measurements at 25° C. of the following cells were made:

$$H_2/NaOH(C_2)/Na_xHg/NaOH(C_1)H_2$$
$$H_2/NaOH(C_1),\ NaCl(C)/Na_xHg/NaOH(C_1)/H_2$$
$$H_2/KOH(C_1),\ KCl(C)/K_xHg/KOH(C_1)/H_2$$

With the results of these measurements and the results of earlier experiments the coefficient of activity, the product of the coefficient of activity and the dissociation of water in solution of NaCl and KCl were calculated. It was found that with increasing concentration of the salt the dissociation increased rapidly, as Arrhenius and Brönsted had predicted. The increase of dissociation soon reached a stationary state, and further increase in the concentration of the salt resulted in a decrease of dissociation. The individual properties of the simple ions in concentrated solutions are discussed in the light of the results obtained and the theory of Debye and Hückel. F. J. B.

2407. *Electrolytic Calcium Arsenate.* **S. J. Lloyd and A. M. Kennedy.** (Chem. and Met. Eng. 32. pp. 624–626, July, 1925.)—Arsenic appears in insecticides in two forms, as trivalent arsenic in the arsenites and as pentavalent arsenic in the arsenates. The former are more toxic than the corresponding arsenates, and would be widely used were it not that they are much more dangerous. As the raw material from which practically all arsenic compounds are made is white arsenic (As_2O_3), some means of oxidising this to the pentoxide (As_2O_5) form is adopted in order to produce the arsenates. The electrolytic process is carried out by dissolving white arsenic in caustic soda (in the proportion of 198 : 250 parts) to form a basic sodium arsenite solution. When this is electrolysed between iron electrodes, hydrogen and a small amount of metallic arsenic are produced at the kathode; but only a very small amount of oxygen is evolved at the anode, the remainder serving to convert the sodium arsenite to arsenate. When the oxidation is completed, the solution is filtered to separate the metallic arsenic, and the filtrate is added to a suspension of calcium hydroxide. The sludge is filtered, and the precipitate of calcium arsenate is washed and dried. The filtrate of caustic soda, after being concentrated, may be used to dissolve fresh arsenic. The raw materials are therefore white arsenic, hydrated lime and sufficient caustic soda to replace the inevitable losses of the operating cycle. It has been shown that the use of purified white arsenic (99 % As_2O_3) which is required for the nitric acid oxidation process is not necessary with the electrolytic process, but that the unpurified "first roast" precipitate, or grey arsenic (90 to 95 % As_2O_3), may be used, thus saving the cost and losses in reroasting the arsenic to purify it. Since the novelty of this process consists in the method employed to convert arsenic trioxide to arsenic pentoxide, it would be expected that other arsenates might be manufactured in the same manner. Up to the present only calcium arsenate has been made commercially, but small-scale production of lead arsenate encountered no serious difficulty. A crystalliser has recently been added to the equipment, so that sodium arsenate may be obtained likewise. J. B. C. K.